AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 16, NO. 43. WEEKLY. | NEW YORK, THURSDAY, OCTOBER 26, 1893. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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Notes from the Fair.

Editorial Correspondence.

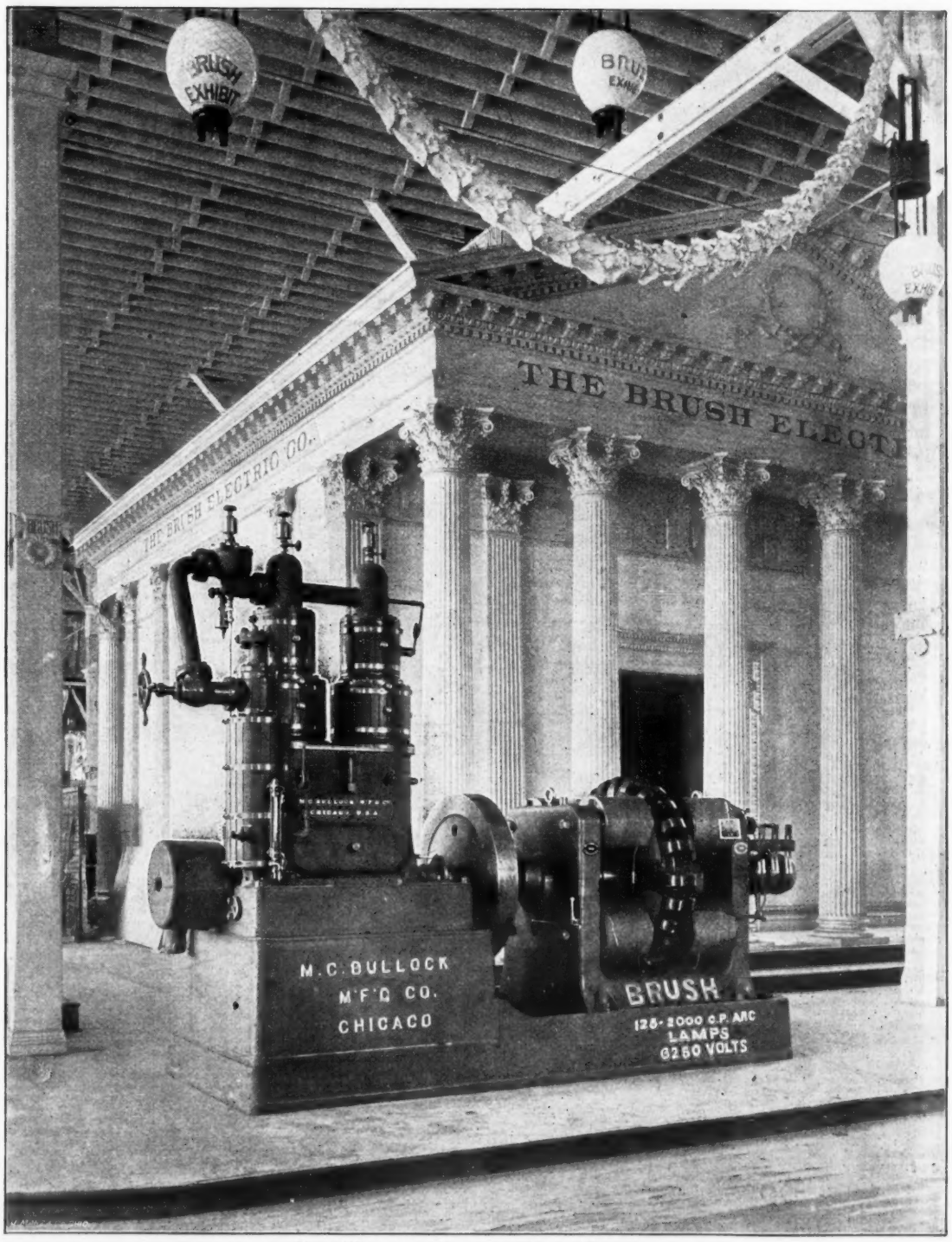
THE WILLANS CENTRAL VALVE ENGINE.

American readers of English technical journals have seen a good deal during the past few years relating to the remarkable economic performance of the Willans central valve steam engine. There are several of these engines here, some built by the English firm of Willans & Robinson, and others by the M. C. Bullock Mfg. Co., of Chicago, who are sole agents and manufacturers of this engine in the United States. All these engines here are much admired for their smooth, quiet running at high speed. The engraving on this page shows one of them coupled direct to a dynamo in Electricity Building, a service for which they are extensively employed in Europe, the small space which is occupied for a given power being one of the considerations which favors their employment in this service. On page 2 is a vertical section of the engine with some of the details shown in separate views.

As will be seen, it is a double, vertical, single-acting engine, and it possesses peculiarities of construction, some of which will be referred to. These engines are built either simple, compound, or triple expansion, and are operated either condensing or non-condensing.

In a general way it may be said that in engines of this type—single-acting vertical—the intention is to keep the thrust always in one—a downward—direction. If this is perfectly accomplished there will be no knocking due to lost motion because the bearing is never changed from one side to the other—from the upper to the lower side. The effort to accomplish this is usually by compression in the steam cylinders, which for reasons easily comprehended is not always desirable, nor even successful in the instance of high-speed engines. In the Willans engine this end is accomplished by quite different means, having no connection whatever with the steam cylinders, hence the steam distribution may be such as is found most desirable, so far as compression is concerned. In fact, very moderate compression is employed in the steam cylinders. The means by which the end referred to is brought about will be explained later.

Referring now to the sectional view (page 2) the operation of this engine may be studied and its construction clearly seen. Beginning first with the connecting rods, it will be noticed that there are two for each line of cylinders, the reason for which will appear presently. A side view of one of these rods is shown in Fig. 1. As will be observed the upper brasses are wider than the lower ones. These last named brasses are subject to no wear, hence there is no occasion for extended surface, enough for safety in an emergency, or in stopping and starting, being all that is required. The upper ends of the connecting rods are journaled in a guide piston which serves as a crosshead, and at the same time serves another and a very important purpose.



THE WILLANS CENTRAL VALVE ENGINE.

The lower ends of the connecting rods dip, at each revolution, into the lubricating material in the crank chamber, which is made tight by means clearly indicated. This oils not only the parts so dipping, but splashes the lubricant—oil and water—over the main bearings and the parts above, keeping them thoroughly lubricated. This is, however, a plan of construction common to other engines. The funnel shown at the left in the vertical section is used for the occasional introduction of oil into the crank case, and is usually placed in front instead of at the side, as represented. A glass gauge, shown in the engraving on this page indicates the height of the lubricant in the crank chamber.

The governor—in this case a throttling governor, although not necessarily so—is shown at the right in the sectional view, its connection with the governor valve as well as its construction being clearly indicated. Through this valve steam passes to the steam chests in the usual manner.

Before, however, the steam reaches the governor valve, it passes through a separa tor, shown at one corner of the bed-plate in the perspective engraving. This separator, which is made as much a part of the engine as any other detail, consists of a deep vertical cylinder, into which the steam from the boiler enters at the top, being conducted through a hanging pipe down into the body of the separator. From the lower end of this hanging pipe the steam turns upward to the outlet, near the top of the separator cylinder. The water, by its superior gravity, continues on to the bottom of the separator, which is fitted with a glass gauge by which to note the height of the accumulated water, and also with a drain cock, which in operation is left just sufficiently open to prevent the rise of water to more than an inch or so in the glass. The plan of making a good separator a constituent part of the engine is one in every way to be commended; if done in the instance of every steam engine it would, beyond doubt, prevent a good many breakdowns.

Passing now to the steam distribution, the arrangement is peculiar, in that the piston valves are located in the hollow piston rod R, which rod, of course, moves with the main pistons, the interior surface of the rod thus becoming a movable valve seat. This makes it necessary to give the valves a motion coincident with the main pistons, except as this motion is varied so as to make the relative position of valves and seat practically the same as if the valve seat was stationary, and the valve moved by an eccentric on the main shaft, in the ordinary manner, which is accomplished by locating the eccentric on the crank-pin, the eccentric being in fact forged solid with this pin. This calls for the employment of two connecting rods, as previously mentioned.

For convenience of identification, the piston valves that will necessarily be referred to in tracing the steam distribution are designated V, V_1, and the ports concerned P, P_1. For obvious reasons the valve V is termed a separation valve and V_1 a distribution valve. Referring to the left-hand engine, the pistons are supposed to be on the down-stroke, having completed about one-quarter of it. Steam from the steam chest is entering the hollow piston rod R (so marked in right-hand engine) through ports P (below valve V_1) and passing to the top of the high-pressure piston through ports P_1, its course being indicated by the arrows.

At about three-quarters stroke the valve V_1 will have been moved by the eccentric so as to cover ports P_1. This would be the point of cut off were it not for the fact that, moving down with the main pistons, ports P have previous to this entered the gland below them, thereby closing all communication between the steam chest and cylinder. The point in the stroke at which this will occur—the point of cut-off—is determined by the thickness of the distance piece D, in the bottom of the packing box, below the metal packing rings. This distance piece may be

of a thickness to bring about cut-off earlier or later in the stroke as may be advisable from a consideration of the steam pressure, load, etc.

When the pistons are near the bottom of the stroke the valve V_1 will have begun again to uncover ports P_1 from below, permitting the steam to pass from the upper to the under side of the piston, that is permitting exhaust to take place into what is the receiver.

So far the distribution of steam with reference to the high-pressure cylinder only has been considered. The distribution with reference to the low-pressure cylinder is similar in all respects, except that, of course, the steam is taken from the receiver and exhausted into the atmosphere or the condenser.

It will be observed that the top surfaces of the main pistons are beveled—dishing—being the lowest next the hollow piston rod, and that the ports extend to the lowest part of the face of the pistons. These ports are, of course, uncovered during all the exhaust stroke—the upward stroke—and the water in the cylinder is swept down and out—its natural course—during the entire period of exhaust. In fact any accumulation of water is on the upper surface of the pistons and in immediate proximity to the ports when opening them for exhaust first begins—just before the beginning of the up-stroke—and is instantly carried out of the cylinder by the action of gravity and the out-rushing steam instead of being carried to the top of the cylinder, abstracting heat all the time from the cylinder walls for its re-evaporation, which is, as is well-known, a fruitful source of loss in the cylinders of steam engines.

This is a matter that does not always receive the consideration due it, it being more common to look upon this loss as inevitable, which to some extent it undoubtedly is, than to take means for modifying it. I believe the means taken to that end in the construction of this engine is a very important factor in its economical performance. I mean not only the provision for instantly freeing the cylinder of accumulated water but the almost as instant sweeping as it were the cylinder walls and the upper surface of the piston of accumulating water, by the out-rushing steam. This, while it will not entirely prevent re evaporation, will, it seems reasonably certain, very materially reduce it.

Going back to the means for providing sufficient cushion on the up-stroke of the pistons, the double purpose served by the guide piston is seen. Its operation will be readily comprehended. Moving up with the main piston it compresses the air in the guide cylinder *C*, the pressure increasing as the space above the piston is diminished, thereby providing a perfect cushion for the main pistons in their up-stroke, keeping the pressure always down on the transmitting parts as before alluded to and permitting the passing of the center without jar or shock. This is accomplished without the addition of extra parts, the guide piston and cylinder operating as an air piston and cylinder.

The guide piston, in its capacity of an air piston, absorbs power during the up-stroke, but the power thus absorbed is returned during the down-stroke by the expansion of the compressed air. It is generally believed that there is considerable loss of heat in an air cylinder working in this way. How insignificant this really is may be seen from an inspection of the diagram, Fig. 2, which is the reproduction of an indicator diagram taken from the air cylinder of one of these engines direct coupled to a General Electric Company's multipolar generator in Electricity Building. The pencil, it will be observed, made practically one line during compression and expansion.

A detached view of the valves and eccentric is shown in Fig. 3, *G* being the valve guide piston, and *F* a guide ring. An inspection of the vertical section will show that the pressure is kept always down on the eccentric and eccentric rod pin by the constant steam chest pressure on the upper piston valve.

The air cock shown at the upper end of the guide or air cylinder is for convenience in turning the engine over by hand, and for use when starting the engine. The relief valves in the pistons are for the purpose of relieving the cylinders from undue pressure from water, or from any other cause. They are plain metallic disks covering a perforated seat, and from the excess of pressure, ordinarily, on their upper surfaces require no spring. The funnel, of which mention has been made, also insures atmospheric pressure in the crank chamber, so that compression in the guide cylinders shall always be from the atmosphere.

Other details of construction are made so plain by the engravings as to require no further reference. When the cut off is made automatic, or adjustable by hand, there is some modification of details.

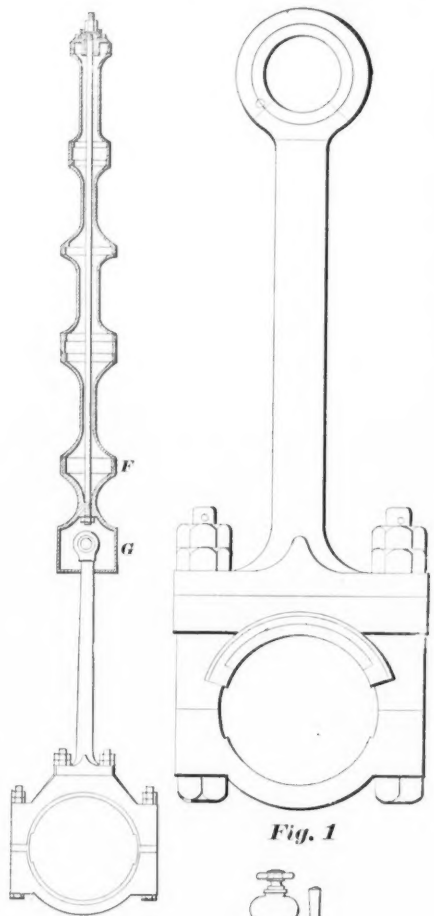


Fig. 1

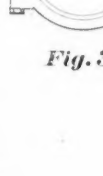


Fig. 3

Schneider & Co., of Creusot, France, exhibited at Paris a Corliss engine which received much favorable comment for its good design. Here they have a center-crank engine of 150 horse-power with a shaft governor. There are two admission valves of the piston type, situated top of the cylinder and worked from rock arms between them. These arms are bent to conform to the circle of the cylinder. The exhaust valves are, apparently, of the Corliss pattern underneath the cylinder. This engine is particularly noticeable for its neat appearance and excellent workmanship as well as for its smooth before being painted. It has on one end of the shaft a band fly-wheel, and on the other a barring wheel of about the same diameter and weight, in which the governor is encased. The cylinder and steam valves are oiled through the operation of an oil pump driven from an extension through its cover-plate of one of the stems of an exhaust valve. A central oil cup at the cylinder distributes oil to the joints of the valve motion through numerous small brass pipes.

This engine in general design would not meet the approval of a good many American engineers. The metal in the bed is, for one thing, not distributed for the greatest strength, still it can hardly be denied that it is strong enough, the argument being really that less metal differently distributed would have made a bed equally as strong. In any event the engine is a handsome one and the workmanship fine.

The Lane & Bodley Co., of Cincinnati, O., have three Corliss engines in service in the power plant. One of them is a cross-compound of 350 horse-power. The cylinders are 16 and 31 inches diameter, and the stroke of pistons is 42 inches, revolutions 75. The bed is a box girder.

Another, a tandem compound, has cylinders 16 and 29 inches diameter, stroke 42 inches, and runs at 80 revolutions, being also rated at 350 horse-power. The bed of this engine is of the usual girder form and is a fine example of that type, massive and handsomely proportioned.

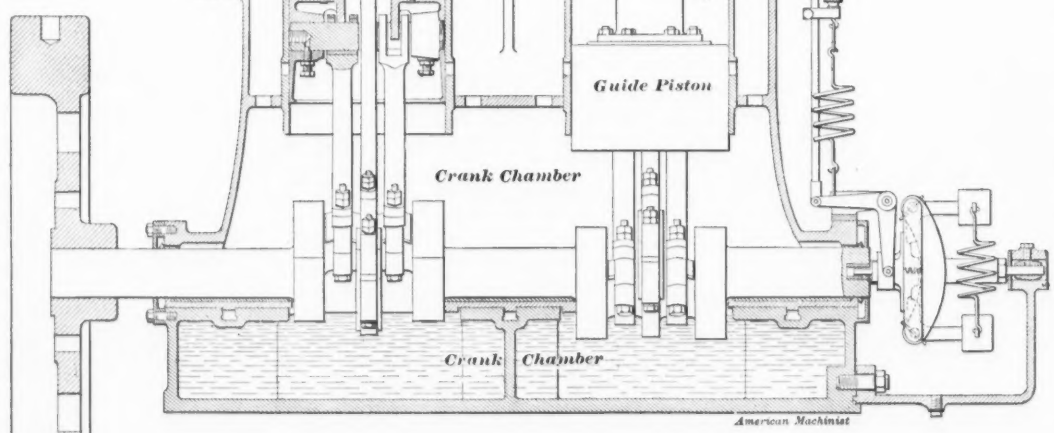
The third engine is a 200 horse-power, simple non-condensing, 18 inches by 42 inches, making 80 revolutions. The bed is a compromise between the other two, having two strengthening ribs but open at the back.

Two of these engines have their pillow blocks cast in one piece with the frame, which, I believe, is the later practice of the company. Two of them have bored guides and one flat guides. The two compounds use a single condensing apparatus of the Davidson make.

In large engines is one by Fraser & Chalmers, of Chicago. This engine is fairly comparable in size with the largest Buckeye engine here, illustrated in our issue of June 22d. It is of the Corliss type, triple-expansion, with high-pressure cylinder 20 inches diameter, intermediate 34 inches, and two 34-inch low-pressure cylinders, the stroke being 60 inches and the speed 64½ revolutions. The fly-wheel is 28 feet diameter and weighs about 50 tons. The bearings of the main shaft are 14 inches diameter, the shaft being enlarged to 18 inches at the center. The governing is on the high-pressure cylinder alone except in case of sudden fluctuations in load, when the cut-off on the low-pressure cylinders is varied for a moment. The connection from the governor for this purpose is through an oil dash-pot, which, when the change of position of the governor is slow, permits the oil to pass by the piston without shifting the cut-off gear on any but the high-pressure cylinder. When the motion of the governor is sudden the oil cannot escape fast enough for this, and the oil cylinder is moved, changing the cut-off on the low-pressure cylinders, the oil gradually finding its way through the by-pass until the cut-off on the low-pressure cylinders is again practically fixed.

In a previous issue we illustrated a vertical 1,200 horse-power German engine. This engine has continued to run in a manner to compel admiration ever since I have been here. It is a highly finished engine, and I am informed would be sold for $30,000. A builder of engines who is here informs me that is about the price plus the duty of an American engine of the same capacity. If my informant is correct it would go to show that it costs about the same to build steam engines in Germany as it does here, as the

Fig. 2.



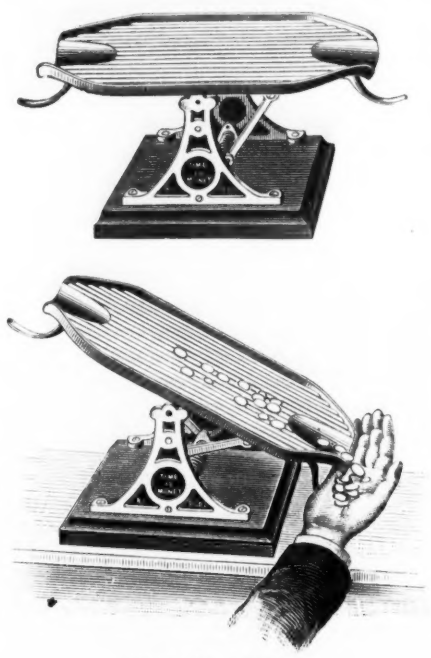
Vertical Section of the Willans Engine.

matter of the extra finish on the German engine is not a great one reckoned in dollars and cents.

The J. H. McEwen Mfg. Co., of Ridgway, Pa., have a compound engine, 12 and 23-inch cylinders, 20-inch stroke, the speed being 200 revolutions. In our issue of April 7, 1892, we illustrated a McEwen simple engine very completely; this engine is the engine we then showed, with some modifications necessary in compounding. H.

Coin Collector.

Every one is familiar with the bother of picking up a number of small coins from a counter; and the rubber mat, the surface of which is covered with small projecting spurs, is, we believe, the best device known here for facilitating the operation. We illustrate herewith, however, a French invention which seems to be a decided improvement upon the rubber mat. It consists, as will be seen, of a small metallic shelf, which normally remains in a horizontal position, and coins deposited upon it are made to slide into either hand by depressing the corresponding end of the table, this being done, as indicated, by pressing downwards upon the small projecting lever seen at either end. Thus but one hand is required, which may be either one that happens to be disengaged or that is most convenient, and the operation is very quickly performed and ought to do much to facilitate business during such rushes as often take place at ticket office windows, cashiers' desks, and similar places. One of these machines is on exhibition in Machinery Hall, at Chicago, and it is made by E. Chouanard, Engineer, Aux Forges de Vulcan, 3 Rue Saint-Denis, Paris, France.



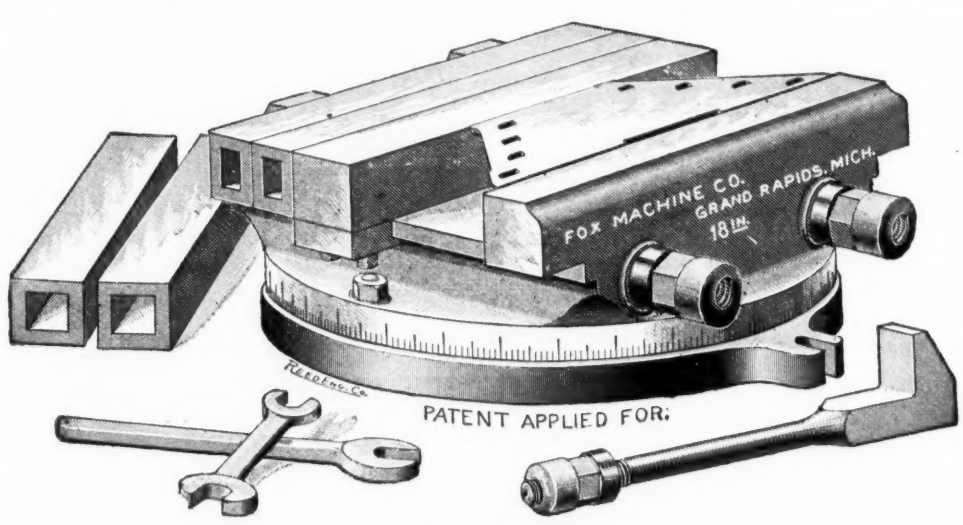
COIN COLLECTOR.

A New Planer Chuck.

The engraving accompanying this illustrates a new form of planer chuck made by the Fox Machine Company, of Grand Rapids, Mich. It will be noticed that things are so arranged in this chuck that when the work is tightened up in it, the tendency is to pull the chuck together instead of to spring or break it apart as in the ordinary construction. In this chuck two bolts pass through the body below the bed of the chuck and these when drawn up simply pull the movable jaw up to the work.

This construction entirely avoids openings through the bed of the chuck, which, of course, are objectionable aside from the fact that they permit dirt and chips to fall through. Hollow parallels are furnished with the chuck for filling in behind the movable jaw as shown.

The swivel base is graduated in degrees and can be set at any angle. Above the hexagonal portion of the nuts there is a knurled section by which the nuts can be turned rapidly by hand. These chucks are made in two sizes, with jaws 12″ and 18″ long, and opening 7″ and 10″, respectively.



A NEW PLANER CHUCK.

About Siphons—II.

BY LEICESTER ALLEN.

The right point of approach to a full understanding of all the principles governing the action of a siphon is obtained by regarding it as a special form of pump. As such, it not only has the general limitations pertaining to all pumps in transferring liquids from one level to another, but also limitations peculiar to itself.

As an illustration that a siphon is a special kind of pump, the apparatus shown in Fig. 4 has been used. In this apparatus, *A* is a tank from which water is to be transferred to a receiving tank *B*. *C* is a tube provided with a removable screw-cap at *D*, and a cock at *K*. *F* is a bent tube extending down into the liquid in the tank *A*, and connected with *C* at *G*. *H* and *H′* are hollow, detached, removable and interchangeable gravity pistons, fitted to work smoothly, yet tightly, in the bore of the tube *C*, and weighted by a quantity of lead shot, or of mercury, contained in their interiors. *I* is a wooden bar, or support, which, when in the position shown, prevents the bottom piston from dropping out of the tube *C*, while, at the same time, it leaves space for outflow of liquid from this tube.

When the apparatus is placed and held by suitable attachments in relation with the supply and receiving tanks *A* and *B*, as shown, the cap *D* is removed, and the cock *K* is turned so as to make a free passage from *A* through the tube *F* into the tube *C*. The piston *H′* is then placed in the upper part of the tube *C* and permitted to drop down and rest upon the bar *I*. Next, the piston *H* is placed in the tube *C* at the top, and allowed to rest supported on the cushion of air thus inclosed in *C* between the two pistons. Next, the cap *D* is screwed upon *C*. The bar *I* is then slipped out, permitting the piston *H′* to drop into the tank *B*, or into the hand of the experimenter, while the wooden bar *I* is adroitly replaced in such manner as to intercept the gravity piston *H* when it in turn falls to the bottom of the tube *C*. After the first piston has fallen, the pistons will fall successively when operated, as hereafter described, and they will slide down the tube easily and smoothly, because their descent at first, forming a partial vacuum between *C* and the level of the liquid in *A*, this vacuum extending down into *C* as the piston descends, the falling motion of the piston will be partly opposed by external atmospheric pressure, and after the apparatus has become fully operative, the same resistance to falling will result.

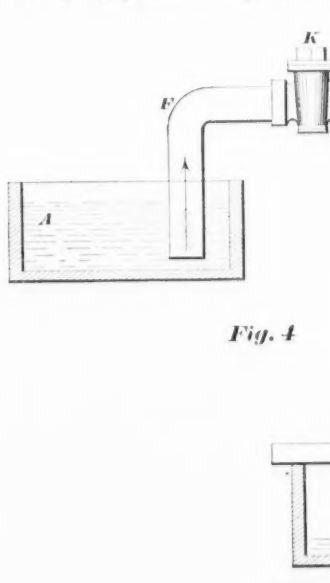


Fig. 4

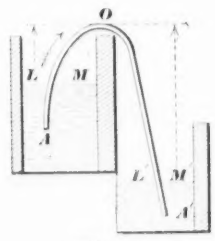


Fig. 5

ABOUT SIPHONS.

The atmosphere presses equally on every square inch of the liquid in the tank *A*, and every square inch of the area of cross section of the bore in the tube *C*. By a law of fluid pressure, this pressure is distributed equally in all directions, and when the second gravity piston begins to fall, there will be a total upward pressure at the bottom of the tube *F* equal to the difference between the full atmospheric pressure upon the liquid in *A* and the weight of the piston, since the weight of the piston acts against the atmospheric pressure in *C*. But as the piston in *C* descends, the pressure on the surface of the liquid in *A* forces up some of the water into the bore of *F*, and the weight of the column increases as it rises. But if the point *G*, where *F* connects with *C*, be at a height somewhat less than that of a column which will just balance the weight of the piston, some of the liquid, when it rises to *G*, will pass over into *C*, and falling down will rest on the top of the piston supported on *I* in the bottom of the tube *C*. The cock *K* being now turned so as to cut off communication between the bore of *F* and that of *C*, the screw cap *D* may be again removed, and the piston that previously dropped out of the bottom of *C* may be placed a second time in the upper part of *C*, by taking out the plug *E* so that an equal bulk of air or water may flow out.

At this stage there will be in *C*, first, the piston in the bottom, resting on *I*; second, a body of water resting upon the top of the lower piston; third, some air above the water, and lastly, the upper piston that has just been put in at the top, and now rests on an air cushion. The screw cap being again put on the top of *C*, the plug *E* screwed in, the cock turned to open a passage between *F* and *C*, and the bottom piston being taken out, the upper piston will fall; there will now be a discharge of water into the tank *B*; and, thereafter, by repeatedly manipulating the apparatus in the manner described, all the water in *A* down to the bottom of the tube *F* may be transferred to *B*.

But if the tube *C* extend down some distance below the level of the liquid in *A*, and if we suppose that, after the air has been expelled from the interior of *C* and *F*, the pistons *H* and *H′* are successively allowed to drop out without replacing them in the tube, the water will still continue to flow, not intermittently, as when manipulating the pistons, but (under certain limitations yet to be pointed out) constantly, as long as water is supplied to *A* in quantity sufficient to maintain the level of the liquid higher than the lower end of *F*.

Thus, starting with a piston pump, we transform it into a siphon, or a pump in which the gravity pistons *H* and *H′* are replaced by successively and continuously formed liquid gravity pistons, these pistons being generated from the liquid itself, and continuously discharged from the tube *C*. The only difference between the two operations (quite unimportant) is that the siphon, while it continually forms new pistons, does not replace its pistons after discharging them.

The earliest intimation that there might be some limitations to the operation of a siphon, other than the mere height of the column in the shorter leg, which I have found in books readily accessible to me, is in a treatise on "Analytical Mechanics," by W. H. C. Bartlett, LL. D., Professor of Natural and Experimental Philosophy in the U. S. Military Academy at West Point, published by Barnes & Burr, New York, in 1865.

In treating of the siphon, the author gives some algebraic formulæ that will be useful in the further consideration of the subject, the description of the instrument, and the mathematical discussion being far more complete than is found in many other text books. The illustration of the siphon accompanying the text quoted below from this excellent work, is reproduced in Fig. 5.

"The siphon is a bent tube of unequal branches, open at both ends, and is used to convey a liquid from a higher to a lower level, over an intermediate point higher than either. Its parallel branches being in a vertical plane, and plunged into two liquids whose upper surfaces are at *L M* and *L′ M′*, the fluid will stand at the same level both within and without each branch of the tube when a vent or small opening is made at *O*. If the air be withdrawn from the siphon through this vent, the water will rise in the branches by the atmospheric pressure without, and when the two columns unite and the vent is closed, the liquid will flow from the reservoir *A* to *A* as long as the level *L′ M′* is below *L M*, and the end of the shorter branch of the siphon is below the surface of the liquid in the reservoir *A*.

"The atmospheric pressures upon the surfaces *L M* and *L′ M′* tend to force the liquid up the two branches of the tube. When the siphon is filled with the liquid, each of these pressures is counteracted in part by the pressure of the fluid column in the branch of the siphon that dips into the fluid upon which the pressure is exerted. The atmospheric pressures are very nearly the same for a difference of level of several feet, by reason of the slight density of air. The pressures of the suspended columns of water will, for the same difference of level, differ considerably, in consequence of the greater density of the liquid. The atmospheric pressure opposed to the weight of

the longer column will therefore be more counteracted than that opposed to the weight of the shorter, thus leaving an excess of pressure at the end of the shorter branch which will produce the motion. Thus, denote by A the intensity of the atmospheric pressure upon a surface a equal to that of a cross section of the tube; by h the difference of level between the surface L M and the bend O; by h' the difference of level between the same point O and the level L' M'; by D the density of the liquid; and by g the force of gravity; then will the pressure, which tends to force the fluid up the branch which dips below L M, be

$$A - a\,h\,D\,g;$$

and that which tends to force the fluid up the branch immersed in the other reservoir, be

$$A - a\,h'\,D\,g;$$

and substracting the first from the second, we find

$$a\,D\,g\,(h' - h),$$

for the intensity of the force which urges the fluid within the siphon, from the upper to the lower reservoir."

"Denote by l the length of the siphon from one level to the other. This will be the distance over which the above force will be instantly transmitted, and the quantity of its work will be measured by

$$a\,D\,g\,(h' - h)\,l.$$

The mass moved will be the fluid in the siphon, which is measured by $a\,l\,D$; and if we denote the velocity by V, we shall have, for the living force of the moving mass

$$a\,l\,D.V^2;$$

whence,

$$a\,D\,g\,(h' - h)\,l = \frac{a\,D\,l\,V^2}{2};$$

and

$$V = \sqrt{2\,g\,(h' - h)},$$

from which it appears that *the velocity with which the liquid will flow through the siphon is equal to the square root of twice the force of gravity, into the difference of level of the fluid in the two reservoirs.* When the fluid in the reservoirs comes to the same level, the flow will cease, since, in that case, $h' - h = 0$."

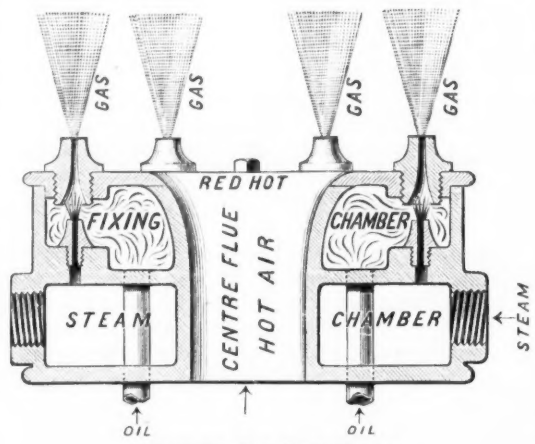
In all this no possible disability is directly stated, and the only hint at such a possibility (of which there are several) is found in the illustration, Fig. 5, and in the statement that both ends of the siphon should be placed below the surface of the liquid. The significance of this restriction will be pointed out in my next article.

Bradley Gas Generator.

The accompanying illustration is of a gas generator and burner, which in use has proven itself very efficient and reliable. It is claimed for this device that the "fixing chamber," being heated to redness at all times when in operation, so thoroughly combines the carbon of the oil with the decomposed elements of the steam as to make a fixed and practically perfect gas.

A relatively small volume of steam is used, and this, together with the fact that the issuing gas is divided into a number of small jets, not only does away entirely with all noise, but insures the most perfect combustion. This is shown in cases where the inside of furnaces fitted with these burners can be seen, and where there is absolutely no appearance of flame within them; they seem simply to be filled with a gas which manifests itself only by its heating effect.

In connection with a retort, these generators are being used successfully for generating from oil a gas to be subsequently consumed elsewhere, the plant for this work consisting simply of a generator outside the retort by which the latter is heated, and one inside by which the gas is formed. This gas, passed through cold water on its way to the holder, shows by the presence of lamp black when the heat of the retort is too high, or by the presence of oil when it is too low, and by adjusting the valves the required conditions, including steam pressure, can be secured and maintained indefinitely. Thus in gas making relatively little attention is required, and the process is a very economical one.



Bradley Gas Generator.

In glass factories and other industries where high and uniform heat is desired, it is used with excellent results.

These generators are made by the inventor, Mr. H. A. Bradley, 20 Nassau street, New York.

The Armstrong Tool Holder for Light Work.

The Armstrong Bros. Tool Company, of 78 Edgewood avenue, Chicago, is now putting up sets of the Armstrong tools with holder consisting of a $\frac{3}{8}''$x$\frac{3}{4}''$ holder, wrench, and nine cutters in a hard-wood case, so arranged as to be convenient, and prevent loss. For use in small lathes especially, this outfit is recommended, and is much more economical than to use the ordinary forged tools.

THE ARMSTRONG TOOL HOLDER, NO. A O.
For General use on Lathes and Shapers.
Cutters can be Ground quickly to any desired Shape or Clearance on a Dry wheel without injury.
PRICE $3.00, BY MAIL $3.25.
PAT. FEB. 28, 93.
Armstrong Tool Holder.

Some of the largest steel plates ever made in England have been turned out at the works of the Consett Iron Company, Durham. They measure 60 feet 2 inches in length, 50 inches in width, and $\frac{11}{20}$ inch in thickness. They are for use in the construction of some large cattle ships which are being built at West Hartlepool for a firm in the United States.—*The Engineer* (London).

Molding an Engine Standard and Cylinder—I.

By Joseph Horner.

In the actual molding of the cylinder and standard, the pattern and core box work of which I recently described, there is less to be noted than in the work of the cores and their connections.

In reference first to the actual molding. It is done like nearly all cylinder work is done—in dried sand. There are two half flasks, top and bottom, precisely alike in outline. One-half the pattern is laid upon a bottom board, and the drag flask laid over it and rammed. Fig. 1 illustrates this first stage of the molding. In this figure, A is the main body of the pattern, B is the half flask or drag, and C is the bottom board. The latter is made with open joints and battens, according to the usual practice.

The principal parts of the pattern, regarded not from the point of view of constructional details, which have been explained in the articles just now referred to, but from the point of view of the molder, are as follows: A is the standard; B' the steam jacket encircling the cylinder body; C' the print for the cylinder bore; D the print for the steam chest; E the print and facing for the steam inlet; F the print and facing for the exhaust; G the flat print for the main core of the standard A; H the print at the bottom of the standard; J the print for coring out between the crank shaft bearing and the main body core which rests on G; K the print for the bearing itself; L the body of the bearing; M M lugs for hold-down bolts. At N N, those portions of the ingates which go into the drag are shown stood upright, and the positions which the runners will occupy when the ramming up has proceeded far enough is shown at O O. The metal is therefore run into the bosses M M alongside the print H.

The drag B is rammed, and then with the bottom board C collared to it, is turned over. The flanges cast on the sides of the flask are for the purpose of facilitating the turning over, the molder grasping them in the hands while the flask is slung in the swivels. The bottom board is then taken away, the joint face strewn with parting sand, and the cope put on. Fig. 2 illustrates the drag B with the pattern rammed up and turned over, ready to receive the top half of the flask or cope. This when placed on is well lifted from the bars and rammed. Two runners are rammed in and two ingates, the runners going, as previously noted, into the two lowermost bosses M M, where the metal will not beat against the main core. The runners and ingates pass alongside the large print H, and a portion of the ingates and the entire runners are rammed in the drag, and the upper portion of the ingates in the cope. These will be seen entire in the figures illustrating the next paper. Sundry pins are rammed up also in the cope for risers, viz., over the positions which will be occupied by the jacket core, the top bearing for the crank shaft, and the two lugs M M which come in the cope. These also will be illustrated in the next paper.

The mold being made in dry sand, while it is drying we will attend to the cores, which involve a much greater quantity of work than the mold itself.

The main core is made in two halves out of the half box illustrated in a previous article. The halves are cemented together. Each is built upon a grid. Fig. 3 shows the grid p placed in the core box in readiness for ramming a half core. It is of cast-iron, the bars comprising it being of square section. Irons a are cast in it, standing out about an inch on one side—the side which faces towards the joint face of the half core—and several inches on the other—the side which faces towards the interior of the box, the lengths of these varying with the varying depths and sections of the core box. Small rods b are attached with binding wire at the small end to support the narrow neck of the core. Holes c are cast for lifting eyes.

There is, however, a slight difference in the grids for the two halves of the cores, provision having to be made for lifting the cores by means of eyes, the stems of which have to be screwed into one of the grids—the lower one—as the core is placed in the mold; that grid has nuts cast into it to receive the screwed ends of the stems. But the stems have to pass freely through the upper grid, and clearing holes are therefore cast through that for the purpose, the metal being bossed up round the holes.

The ramming of the two half cores is al-

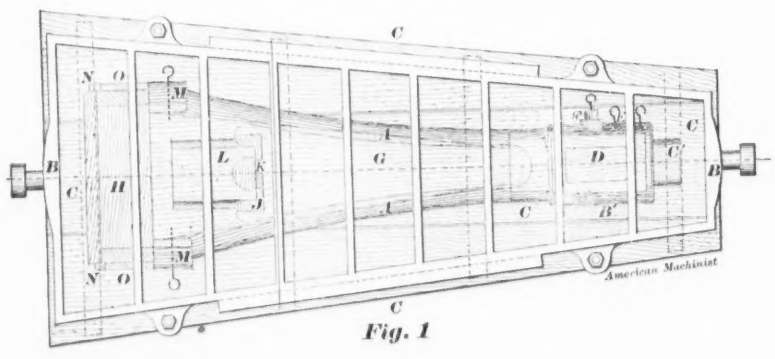


Fig. 1

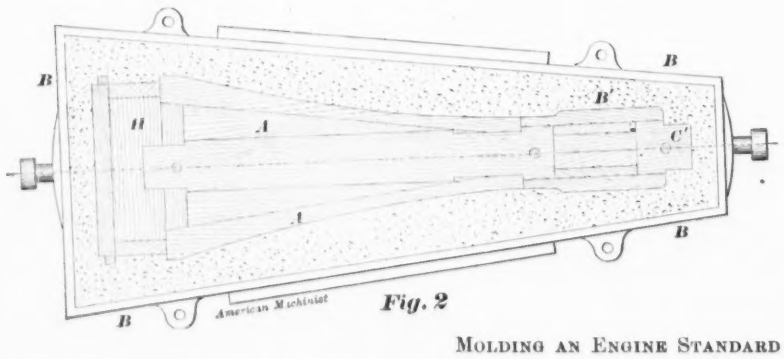
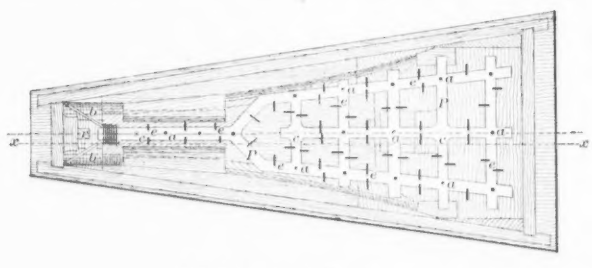


Fig. 2



Section on Line x x.

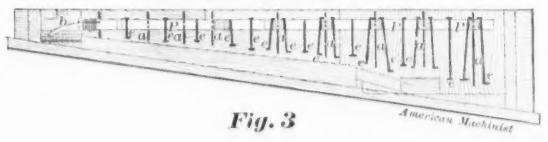


Fig. 3

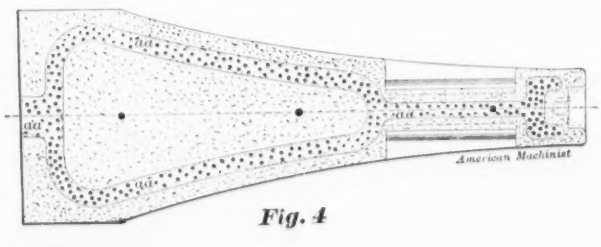


Fig. 4

Molding an Engine Standard and Cylinder.

most identical with that of a mold. Since the core is of considerable depth at and near the base, lifters *e* are hung from the grid down into the box in those localities to assist in supporting the sand thereabouts. Also a considerable mass of cinders is rammed in and about the central portions of the core to form a reservoir to the vents, which are formed with the vent wire in all directions. Air channels also are cut in the joint face of each core, into which the vents pass, and whence the air escapes. Fig. 4 shows the joint face with air channels *a a*, and vents.

When a half core is rammed, its joint face is strickled level with the joint face of the box, with a straight-edge. Then a cast-iron plate of say ½" thickness is laid upon the face and clamped to the box sides. The box, plate and core are then turned over bodily, the screws taken out from the box sides, and the several pieces of which it is composed removed singly away from the core, leaving it standing upon the plate, upon which plate it is put into the stove to be dried.

LETTERS FROM PRACTICAL MEN.

Epicycloidal Teeth For Abnormal Bevel Gears.

Editor American Machinist:

The Bilgram spiral bevel gears illustrated in your issue of October 12th, are certainly of great interest to cut or planed gearing experts, as also in still greater degree the straight bevel right-angled gears of three different diameters meshing into one and the same mating bevel gear.

I take the style of tooth to be the involute without finding it stated, which form I believe can be shown by theory to work correctly for the gears described. We would, however, be glad to hear from Mr. Bilgram as to his convictions or his experience with the *epicycloidal* form of tooth in bevel gears where three different sizes of gears mesh with a common mate, whose axis is at right angles to those of the three former named gears S. W. Robinson.

Ohio State University.

Editor American Machinist:

Prof. S. W. Robinson calls my attention to an omission in my description of the theory of the quadruplet of bevel gears published in the American Machinist, October 12th. The problem of making bevel pinions of different diameters, adapted to gear at right angles with the same bevel wheel, can be solved only by the use of involute teeth, or of closely allied forms. If the teeth of the normal pair were of the cycloidal form, those of the abnormal pinions would assume impossible shapes.

Hugo Bilgram.

An Improved Shaft Turning Device.

Editor American Machinist:

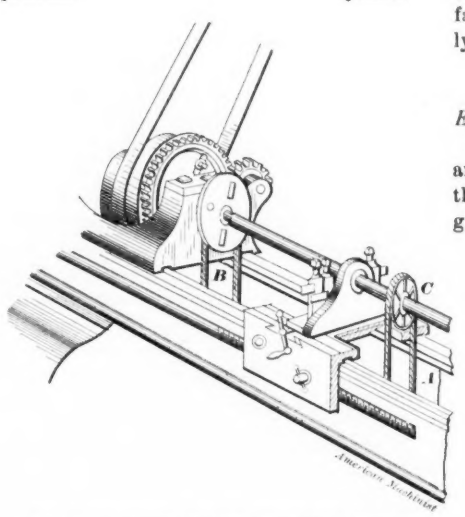
Perhaps there is no operation that comes within the scope of an engine lathe to which more attention has been given than that of turning shafting. One improvement after another has been added to shafting lathes, until the actual work of turning has become an inconsiderable quantity, compared with the preliminary and after operations of centering and straightening. For example, a two-inch shaft twenty feet long requires but forty minutes from the time the cut is started until it reaches the driver at the other end. If the remainder is to be turned, an hour or more may be consumed in reversing ends, re centering, and turning less than a foot in length. If to save this time the rough end is cut off, this much of the shaft is reduced to scrap, and frequently another center must be made in order that couplings may be fitted.

The improvement described below is the invention of Mr. S. E. Shattuck, of Chattanooga, Tenn. It dispenses with all the additional labor just mentioned, by enabling the operator to continue the cut to the end of a shaft without appreciable delay.

The accompanying illustration shows the application of this device.

By means of sprocket wheels, and the link belts *A* and *B*, motion is transmitted from the lathe spindle to the shaft being turned. A short countershaft is attached between the lathe shears. The sprocket wheel *C* is placed on the shaft when the turning begins, and when needed it is put in position and made fast by means of set-screws. The driver is then removed and the turning continues to the end of the shaft.

The time consumed in making these attachments will not exceed five minutes. The full length of the bar of iron is utilized, and better work is done than by the old process. Quirk.



An Improved Shaft Turning Device.

An Old Device—Packing Rings.

Editor American Machinist:

I notice in your paper of October 12th on page 4 an illustration of a blower which tends to prove the truth of the old proverb that "there is nothing new under the sun."

A fire engine having the same identical form of construction in plan and details was in use fifty years ago, one of which was in use in this town at the village of North Bennington, and after many years' use was bought by a paper mill firm who used the pump for a fire extinguishing apparatus, driving it by power. When used as a fire engine a crank was applied to each end of the shaft with the crank handles extended so they were about 5 feet long, so that 3 or 4 men could take hold of each side of each crank—12 to 16 men in all. The machine was quite efficient to throw water to heights up to 50 to 75 feet by hand, or to greater heights by power.

I also notice on page 7 of same paper Mr. Frank Richards description of his method of grinding or turning a packing ring to circular form after it was cut open, and sprung to nearly right size by a flexible band.

I have found that method unreliable unless repeated, for the reason that I could never "leave just enough on the outside for the final operation," but by turning of the exterior surface of the ring the tension of the different parts of the ring would be changed, and when the clamping plates were released the ring would assume a new form, but by repeating the operation once or twice of closing the ring with the band, clamping and turning, I could get the ring fairly true, so as to press cylinder very nearly equally all around. Olin Scott.

Handy Gear Tooth Rules.

Editor American Machinist:

I notice that Mr. Campbell is at me with another "handy rule," and judging from the very pretty drawing presented, he has given me a hard one to dismount. In fact, I will commence by saying that it is the best one of the kind that I have seen, and that the acquisition is well worth this series of discussions. I thought likely I could get hold of something by stirring up the cast gear men.

So far as I have studied the subject the rule is novel, and we will call it Campbell's rule. The idea of drawing the curves from the pitch points is old enough, but the variation of carrying the face curve down below the pitch line and then meeting it with a flank curve drawn tangent to it is apparently novel, and is the saving feature of the method. If we must have a "handy rule," let us take this rather than the Haswell or the Calvert rule.

Let us examine this rule and see just what are its merits and defects. The small drawings given in Mr. C.'s article tell but little, and I have drawn the two leading positions—12 teeth into 12, and 12 teeth into a rack—on a larger scale, giving the contact at intervals of quarter teeth. The other combinations of numbers of teeth would probably show nothing new.

Taking 12 teeth into 12, the contact at the pitch point *A* is perfect by construction. At *B* the curves intersect, but not enough to be evident. At *C* the intersection is very evident. At *D* the curves clear each other. Therefore at some intermediate point, as *E*, there must be perfect contact. Notice that the "line of action" is practically a straight line, and the teeth are therefore practically involutes.

Taking the 12 teeth into a rack, the contact at the point *C*, half a pitch from the pitch point, is perfect by construction. At *D*, *B* or *A* the contact is nearly perfect; at *E* and *I* it is good enough; at *G* and *H* it is very bad as there is a long intersection, while at some point *J* it must be perfect for an instant. The line of action is a curve that does not pass the pitch line of the rack, and the teeth are therefore of a nondescript variety not within the confines of theory, for the theoretical line of action of an interchangeable set of gears invariably passes through the pitch point, and is alike on both sides of the rack pitch line.

Notice that the line of action in neither example touches the under flank or flank drawn tangent to the face curve, and therefore the part of Campbell's rule that requires this under flank to be drawn from the middle of the adjoining tooth is not essential. The under flank is never in contact, and is therefore nothing but a "fillet" which may be more easily drawn from either pitch point of the adjoining tooth. Draw it straight for center as for the involute tooth, or any other way to get it out of the way of the engaging tooth.

There are two defects of this rule. One is the concentration of the action upon a small portion of the curve and the consequent rapid wear and destruction of that part. It is this defect—a very common one—that causes the digging out of gear teeth near the pitch line. The other defect is the intersections at *G* and *H* of the rack, and at *C* of the pinion combination.

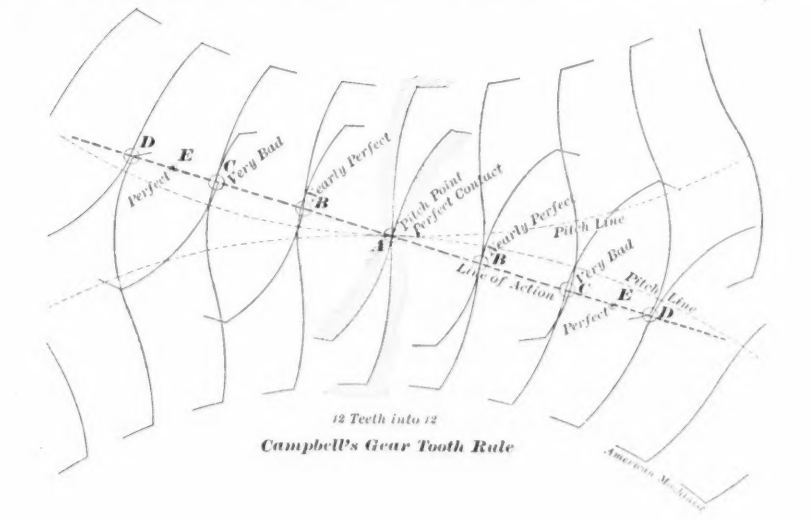
Whether this rule is preferable to the odontograph or not depends on the purpose, and somewhat on the laziness of the draftsman. For coarse cast gearing it is good enough. Where Mr. Calvert's teeth, all humps and corners, give practical satisfaction, as claimed by him, this rule is perfect. For purposes of drafting teeth that are never to be constructed by the drawing it is the very thing needed, for it is simple, neat, and good enough for that purpose. The defects will not show on a drawing of teeth of ordinary sizes. For cut gearing the intersections prohibit its use.

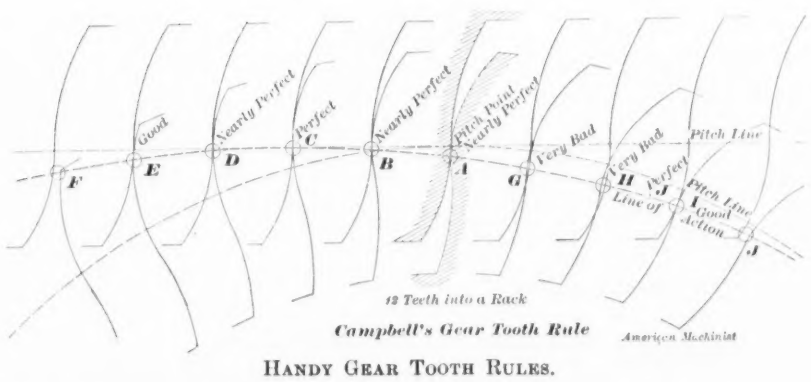
For my own use I still prefer the odontograph, for although it requires more work, it gives a better result. For drafting teeth I admit that this rule is a good one, but should change it by drawing the under flank or fillet curve from the further pitch point of the adjoining tooth instead of from its center.

I object decidedly to one feature of Mr. Campbell's work—the use of the chordal pitch. If there is anything that is well established in the theory of gearing it is that the circular pitch of two engaging teeth should be the same, and the feature of the chordal pitch is that the circular pitches of two gears of different numbers of teeth are never the same. He says that it is seldom if ever mentioned in works on gearing that the pitch of a rack should be equal to the circular pitch of the gear with which it meshes. I do not know of a work that does not mention that fact. In fact, it would be a botch of a work on gearing that did not teach that the pitch should be the same for all numbers of teeth.

Mr. C. asks if the true tooth curve has been determined, and by whom. There is no such thing as "the true tooth curve," but "a true tooth curve" is easily defined. The most comprehensive generalization of the theory lies in the statement that all gear teeth that will engage with a symmetrical rack tooth will engage with each other. The inventor of the gear tooth is as indeterminable as the inventor of the steam engine, for it is built up of many contributions. Euler, De La Hire, Camus, Willis, Sang and many others have had a hand in it, but there is no one man to stand for any great part of it.

Mr. C. calls for a proof that the center of the tooth curve is dependent on the number of teeth in the gear, by which I suppose he refers to the position of the center of the circle that most nearly approximates to the true curve. The proof is that theoretically true tooth curves are invariably of varying curvature, and circles to agree nearly with them must be of varying radii. Taking the





Handy Gear Tooth Rules.

standard epicycloidal tooth for an example, it is found that the rack tooth curve nearly coincides with a circle having a radius of .94 of the pitch, while the flanks of teeth of 97, 33, 20, and 16 toothed gears require circles with radii of 1.00, 1.20, 1.63, and 2.40 of the pitch. If the radius of the circle is dependent only upon the pitch, it is practically uniform. This fact is true of all teeth, varying in amount according to the kind chosen.

Mr. C. says he has been waiting in hopes that possibly some one might explain the whole matter to every one's satisfaction, and I think he has still a long time to wait. It is impossible to reconcile the advocates of the various systems of gear teeth in actual use, not to mention the proposed systems and the numerous handy rules. Which tooth is the best is to a large degree a matter of opinion, some preferring the involute, some the epicycloidal, while I am of the opinion that there is something better than either. If a dozen different systems should be proposed there would be a dozen systems in use, each one the best in the opinion of its friends. There does not appear to be universal satisfaction in anything human, and no sign of an agreement in the matter of teeth of gears. GEORGE B. GRANT.

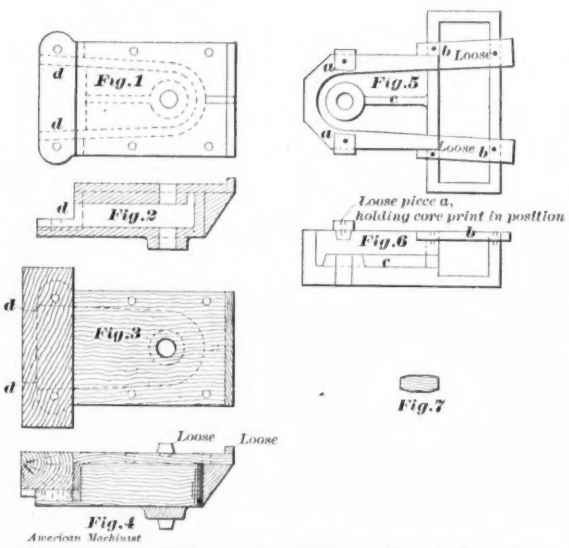
Pattern for Locomotive Tender Draw Casting.

Editor American Machinist:

I send a drawing of the above, also pattern and core-box for same. When the patternmaker is requested to make any pattern his first thought should be the requirements of the molder and coremaker, viz., how the former can have the most or all of the casting in the drag, thereby saving time in the drawing of pattern and securing a good fall for the metal without having to "build up" above the cope for pouring basin, and the latter must have the core box made so that the "plate" can be laid on a flat face when turning out of box. True in some particular cases we have to make a core for a seat when the core proper has projections, but it is very rarely done and should be always avoided if possible.

Fig. 1 shows the top view and Fig. 2 a longitudinal section of casting; Figs 3 and 4, top and edge views of pattern, the core print and lug loose as shown; all bolt holes leave their own core. Figs. 5 and 6 show core-box; the latter is intended for a sectional view. It will be noticed that the core is made in an inverted position to what the pattern is molded, and that it requires more pieces.

The loose part *a* is intended to hold a core print concentric with the draw bolt hole to form a seat to receive a short round core, Fig. 7, which acts as a support for main core and forming hole through bottom of casting. The piece *b* is held in position by pins and is required to form the inner face of casting as seen at *d*, Figs. 1, 2 and 3. After the core is rammed up these three pieces are removed, and then the core can be readily turned out. I have not shown the method of constructing pattern, but would say that in this and in every case where it pays to do so it is hollow. By this we save material; it is lighter for molding and is kept truer. WM. NEWTON.



PATTERN FOR LOCOMOTIVE TENDER DRAW CASTINGS.

Case-hardening Cast-iron.

Editor American Machinist:

One of your readers asks advice regarding case-hardening of cast-iron. We have had good success by using cyanide of potash. "Soak" well in moderate fire and dip in cold water. Treated this way cast-iron is a good substitute for steel in many places.

E. F. S.

Failure of an Eighteen-foot Engine Pulley at the Third Avenue Street Railway Power House, Brooklyn.

Editor American Machinist:

The failure of an engine pulley on the evening of October 11th wrecked a section of the brick power house, destroyed one large Westinghouse generator, wrecked the tandem compound engine to which the burst pulley was attached, and damaged a similar engine alongside the one which was wrecked. Portions of the wheel also wrecked two houses several hundred feet from the engine house.

The precise cause of the accident has not yet been made public, if indeed it is known, but the points given herewith will be of interest to your readers.

Just before the accident, there was a "heavy ground" on one of the lines, and that means that a great rush of current would take place, escaping through the "ground," and that each generator would be taxed to its utmost to maintain the required voltage during the continuance of the "ground."

Indeed, it was stated by an employe, an electrician, that three generators were running at the time, and the switches of two generators "blew out" just before the accident. This, in plain English, means that the current in the live wires became so great that the automatic switches of two of the generators were operated by the too heavy current, and opened the circuits, thus putting two of the three generators out of use.

But one generator (the wrecked one) was left in use by the above occurrence, and it is supposed that the load thus thrown upon it was too great for the generator to carry. Had the automatic cut-out acted promptly, a different story might have been told, but it is stated by employes who were present at the time of the accident, that the heavy current burned out the armature of the remaining generator; also, that it burned out the field magnets.

It is further stated that at this time the engineer started towards the throttle to shut down the engine, but before he could reach the valve, the *generator pulley went to pieces*, first, and the engine pulley immediately followed.

This may be the truth, but from a study of the wreckage a few hours after the accident, and before it had been touched, it looks as if the large pulley gave way first, and that bombardment by the pieces of rim and arms had caused the damage to the wrecked dynamo, smashing its pulley, etc. This supposition is borne out by the marks where flying iron had struck armature and fields, breaking the winding, and cracking the frame of the machine in several places.

Had the generator pulley failed first, and entanglement of the belt on the broken pulley arms caused the failure of the engine pulley, the generator frame casting would have been broken by a pull *towards*, instead of from the engine. But all the breaks and fractures show that the generator was broken by being forced *from* the engine, precisely as would occur under the hammering of several tons of old iron striking with a velocity of about 56 feet per second.

The position of the crank-shaft is also peculiar. It was raised vertically upwards at the time of breaking, and lifted out of the outboard bearing, breaking one end of the cap and one of the cap bolts. The crank end was also lifted up out of its bearing, but the outer side of bearing was broken off of frame The shaft was hurled upward with such force that the pistons both struck against their respective heads at crank end of cylinders, stretching the cylinder bolts, and shearing the crosshead pin and key, consisting of a section of steel aggregating 1x3½ inches. This was cut clean in *double shear*.

The crosshead then passed half way out of the guides, and turned upwards. Just then the return stroke of the crank occurred, and the crosshead was brought against the sharp end of the upper guide with such force that a triangular hole three inches long and over one half inch deep (and several inches wide) was sheared out of the crosshead gib by the end of guide. This shows the tremendous power at the time of the accident.

The shaft was thrown out of its bearings as follows: Standing in line with the shaft and facing the crank, the crank end of shaft was thrown to left, the outboard end of shaft to right of its running position.

The jaws of out-board bearing being uninjured, and the shaft lifted upward, out of its bearing, shows that the first or initial rupture of the engine pulley must have occurred at the junction of the arms with the hub. There are two pieces in the hub, ten arms and ten rim segments, all cast separate and bolted together. It leaves the arms about 7 feet long (18-foot wheel).

From present appearance (at the time mentioned) it appears that the initial rupture was through the arms close to the hub, or through the bolt holes which fastened arms to hub. In fact, it looks as if all the arms twisted off at the hub, and some of them at rim also, the pull of belt then drew the wheel towards the dynamo, and caused the rim to approach the shaft so that the latter passed in among the arms on side of wheel which was running in an upward direction.

The momentum of the wheel rim caused the fragments of the spokes remaining attached to it to lift the shaft out of its bearings. The rim running loose, without support from its arms, was thrown against a brick floor extending from near face of engine pulley to the dynamo.

This floor was built of flat brick arches between parallel iron I-beams, and 15 or 18 feet by 10 feet was torn by the wheel revolving against it, before, and by the flying fragments during the collapse of the rim.

According to statements made by employes, that the generator pulley gave way first, and under a heavy load, the engine pulley must have failed under the sudden *release* from its heavy load, the jerk or "kick" to which the pulley arms were subjected being too much for their strength.

Appearance of the generator indicates that it was injured by flying iron, rather than by burning out. Consequently the generator pulley was demolished *after*, and *by the failure* of the engine pulley.

There are two theories that may be supported by circumstances as far as I have seen them.

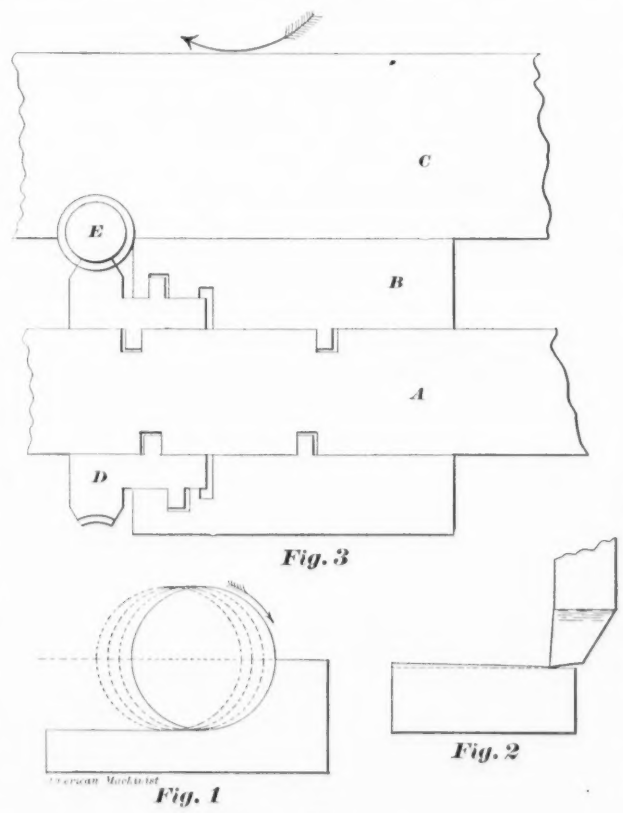
1st. The generator was overloaded, burned out, and the sudden removal of load caused its own pulley to go to pieces, bringing in the train of this minor accident the others already described, much like the old story of "The House that Jack Built."

2d. The sudden and heavy increase of load when cut outs Nos. 3 and 4 "blew out," caused so severe a strain that the arms of engine pulley twisted out like the spokes in an overloaded cart wheel.

It may be in order to state that at the point where most of the arms broke off, a few inches outside the hub, they were oval in section, 14½ inches wide, 5 inches thick, and cored out so the metal was 1⅝ inches thick all around. The pulley rim was stiffened by four ribs inside, one being at either edge of the rim, the others each side of center. To these central ribs, the arms were attached, a plate being cast across from one rib to the other, and the arms bolted to the plates. Every one I saw broke off clean and sharp at junction of plate and ribs.

The section of building wrecked was taken out by the removal by the bombardment of one of the iron trusses. The truss was located directly over the engine, and the flying iron lifted the entire truss, bent it so as to shorten it considerably, then it fell back into the building, the wall under it at one end having been entirely demolished. The falling in of the roof truss brought with it two sections of the roof. The truss in its fall came down on a companion to the wrecked engine, damaging that also to some extent.

JAMES F. HOBART.



ABOUT MILLING.

About Milling.

Editor American Machinist:

The direction that a milling cutter should run in relation to the feed is receiving more attention just now than ever before. As it has been, it has been considered sufficient reason for running the cutter against the feed, just to keep the "backlash" out of the screw, but it looks now as though before long we shall see plenty of machines built with other means of doing away with the "backlash."

I have noticed many times that it took a surprising amount of pressure to make an axial mill cut, when in comparison with lathe or planer tools that would work well, the mill seemed to be very sharp. In such milling the chip either starts at nothing and grows thicker or the reverse, depending upon the direction the cutter revolves.

In Fig. 1, if we let the dotted circles represent the path of the cutter, it is plain that if the cutter should run in the direction of the arrow, the chip would start quite thick and run out to nothing, or if in the other direction the reverse would be the result. Suppose we have a slightly wedge-shaped piece to plane parallel, as is shown in Fig. 2. If we use a flat nosed tool and start

to plane from the thin end, we will find that under ordinary conditions the tool will "ride" for a short distance, when it will take hold all at once, but if we plane from the thick end, the tool will take hold right away and remain in its cut longer. If there is much of such planing to do, we will find that we can do better work and the tool will keep sharp longer by planing from the thick end. I think this is just the principle in the milling. Of course, in taking a cut 4″ wide we should expect it to take more pressure to hold the tool to its work than in one 1″ wide, but I believe it will take less when the cutter runs as in Fig. 1, than when the reverse is the case. Did you ever notice the glazed appearance of milled work? If so, compare it with the thin end (or what was the thin end) of a piece like Fig. 2, after planing it from the thin end.

There seems to be a limit to how small a cut we can take, as well as how large.

With a tool $\frac{1}{2}$″ in width a planer must be very rigid in order to take a cut .001″ in thickness; in most cases it will take either more, or none at all.

Suppose we are using a cutter of 32 teeth and the feed is $\frac{1}{16}$″ to the turn.

Suppose for the sake of theory that the cutter runs perfectly true—a case I have not yet noticed.

There would be about .002″ cut for each tooth, where it starts in, that is, if it was cutting as deep as in Fig. 1, but where each chip runs out, the thickness would be too small to mention, in fact too small to cut at one time, so the tooth "takes a ride" till there is a decent chip to take, when it takes it all at once.

When a tool "rides" under pressure (especially on cast-iron where there is sand) it gets dull very fast.

I do not favor this kind of milling in a place where a face mill can be used. Face milling is a different principle, and does not require nearly so heavy a machine to do good work. Axial mills must, of course, be used on many kinds of work.

It might be an advantage to have all milling machines so arranged that the backlash could be disposed of when desired, so as to allow cutters to be run in either direction in relation to the feed. In Fig. 3 suppose *A* represents the screw of a milling machine, *B* the nut, and *C* the platen. *D* is a small worm-wheel, and *E* the worm. The hub of *D* is threaded and fitted into a recess in the main nut; it is also internally threaded to fit the screw *A*. The incline of thread on the hub *D* is the reverse of that on the screw *A*. A very small turn of the worm *E* in either direction would throw the bearing of threads in main nut either to one side or the other, or if midway, throw out the adjustable feature altogether. If used in the right way the adjusting nut *D* would have very little work to do. I have only drawn in one thread in a place, just to show where the bearings would come when the cutter is turning in the direction of the arrow. The cutter would do most of the feeding, and the main nut would take the thrust. If the direction of cutter should be changed, then the worm *E* could be turned so as to throw the bearing the other way. I don't know as it would be necessary to provide for running the cutter either way, and as it is about impossible to keep a rigid nut a good fit upon a screw where it is used a large part of the time on that work.

If it is adjusted to fit a place that is worn then it is too tight for other places. I should omit the external thread on the hub of *D*, and provide in its place a stout coiled spring, then by the use of the worm and wheel the spring could be tightened or released at pleasure, and the nut would run smooth the whole length of screw, even after it was considerably worn in places. I do not think it would be a good plan to use a spring without some tightening and releasing arrangement. Sometimes the spring would need to be quite stiff, and at other times it would not be needed at all, so without releasing there would be unnecessary wear.

A Mechanic.

The Old and the New Way of Running Milling Cutters.

Editor American Machinist:

The question by F. H. Colvin in October 5th issue, asking for an explanation of the advantages to be derived from running mills over onto the work, Pratt & Whitney fashion, as against the old way, leads me to relate my experience. Not long since I had to cut about 1,000 slots in steel castings; these slots were .029″ in width by $\frac{3}{16}$″ deep, and at one place $\frac{1}{4}$″, and most of them were $8\frac{1}{4}$″ long. They were cut in cylinders, and so close together as to leave about the same thickness of metal standing as the thickness of the cut. The metal was close-grained, tough, and very strong, not hard, yet having somewhat of that greasy toughness of phosphor bronze. The cutters used were Brown & Sharpe metal slitting saws, $2\frac{1}{4}$″ diameter, 22 teeth, and were supported by collars, leaving only some $\frac{5}{16}$″ projecting beyond them.

The work was started in the ordinary way, the cutter making 80 revolutions per minute, and the slowest feed used = 136 revolutions per inch; the cutter would run off, and in $\frac{3}{4}$″ to 1″ would get away far enough to break; this, of course, after it got slightly dulled. I thus broke two cutters in the first 40 slots, so I decided to try the other way of running—to run the cutter over. A weight of 100 pounds was suspended by a rope over a pulley, and the rope attached to milling machine table, so as to resist the draw of the cutter while the screw did the feeding. After this change I once cut 92 feet of the before mentioned slot without grinding the cutter, and was using double the feed I dared to before. I broke no more cutters, and had no further trouble; the cut always ran straight, and the cutter stayed sharp much longer than when running the old way. I account for this last in this way: Each tooth gets the whole depth of its cut at once, and in this way gets a good hold of the chip, while in cutting out, the cutter teeth are starting with nothing, and it gradually thickens up, until on leaving the metal the full depth is reached. In running the other way the conditions are exactly reversed. The cut starts full, and runs out at nothing.

It is well known that a reamer will wear longer when used in holes in which it has enough to remove to make a chip, instead of merely scraping. The milling cutter when used the old way has to work at the disadvantage of having to scrape all the time, until the pressure of the feed is great enough to make a decent cut.

Charles S. Beach.

A large propeller blade has recently been made in England in which a coating of copper was united to the cast-iron. The copper sheet was placed in the mold, and when the iron was poured it united by fusion with the copper. The process is patented.

Society of Naval Architects and Marine Engineers.

We learn by notice from the secretary that the first general meeting of this society will take place in the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, on Thursday, November 16, at 10 A. M., the sessions extending through Thursday and Friday. The secretary urges full attendance, and that members will advise him of their intention to attend. His address is, W. L. Capps, 1710 F street, N. W., Washington, D. C.

The list of papers is as follows:

PRELIMINARY LIST OF PAPERS TO BE READ AT THE INAUGURAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

1. "Transatlantic Navigation."—Charles H. Cramp, Esq., President, Wm. Cramp & Sons' Ship and Engine Building Co., Philadelphia, Pa.

2. 'Steel Ships of the United States Navy."—Theodore D. Wilson, ex-Chief Constructor, U. S. N.

3. "The Development of Shipbuilding on the Great Lakes."—Jno. F. Pankhurst, Esq., Vice-President and General Manager, Globe Iron Works, Cleveland, Ohio.

4. "Notes on the Machinery of the New Vessels of the United States Navy."—George W. Melville, Engineer-in-Chief, U. S. Navy.

5. "Coal Bunkers and Coaling Ships."—Albert P. Niblack, Lieutenant, U. S. Navy.

6. "Production in the United States of Heavy Steel Engine, Gun and Armor Forgings."—Russell W. Davenport, Esq., Vice-President, Bethlehem Iron Co., South Bethlehem, Pa.

7. "Determination of the Approximate Dimensions of a Vessel to Fulfill a Given Programme of Requirements."—Joseph J. Woodward, Naval Constructor, U. S. N.

8. "Comparative Performances of American and Foreign Freighting Ships—Our Superiority."—Wm. W. Bates, Esq., late Commissioner of Navigation, Treasury Department.

9. "The Wetted Surface of Ships."—David W. Taylor, Naval Constructor, U. S. N.

10. "The Influence of Speed and Weight of Machinery on the Determination of the Other Elements of the Design of Steam Vessels."—John J. O'Neill, Esq., Naval Architect and Marine Engineer.

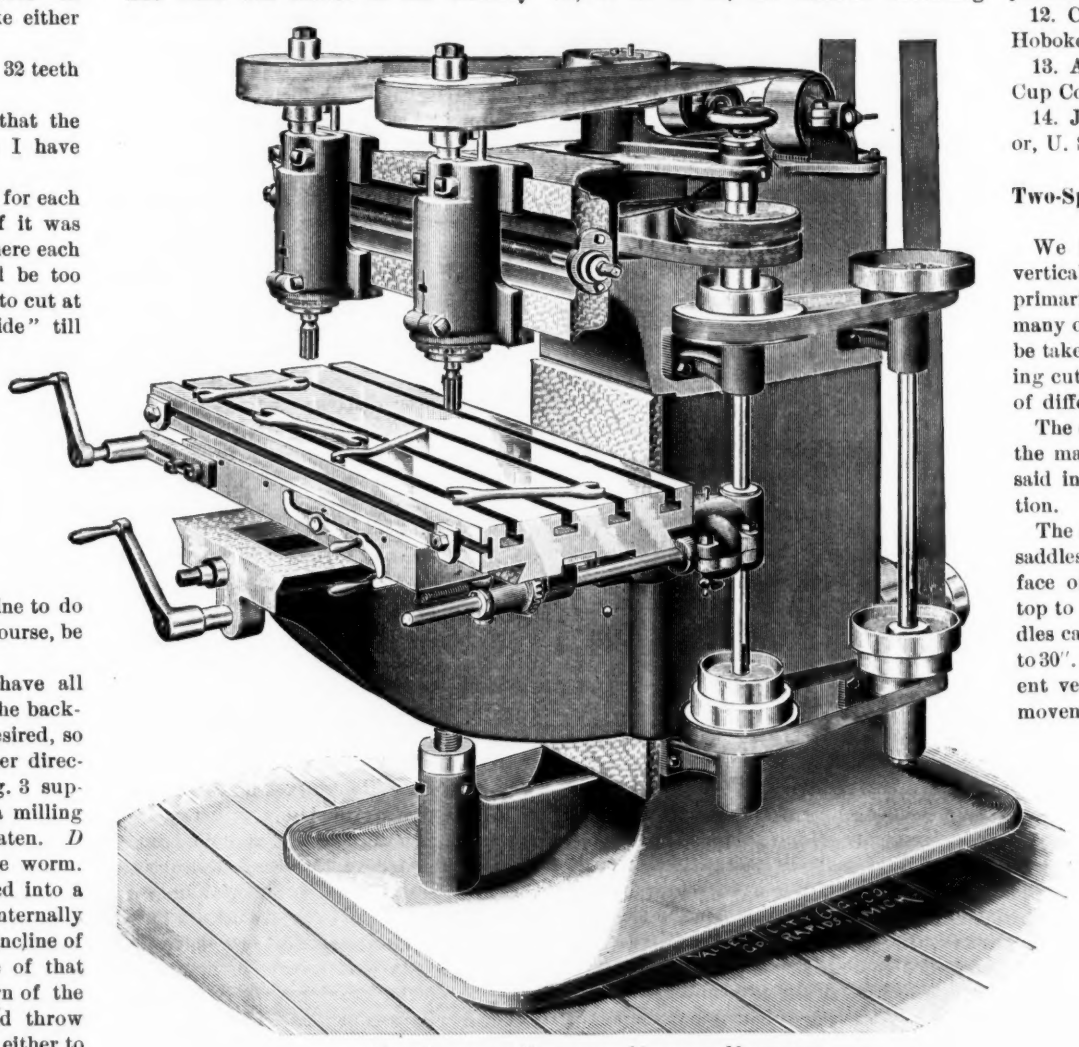
11. "United States Treasury Rules for the Inspection of Machinery and Boilers."—Jas. T. Boyd, Esq., General Manager, George F. Blake Manufacturing Co.

Papers are also expected from the following gentlemen, but the exact titles have not yet been decided upon:

12. Col. Edwin A. Stevens, President, Hoboken Ferries.

13. A. Cass Canfield, Member America's Cup Committee, New York Yacht Club.

14. Joseph H. Linnard, Naval Constructor, U. S. N.



Two Spindle Vertical Milling Machine.

Two-Spindle Vertical Milling Machine.

We illustrate herewith a double spindle vertical milling machine, which is designed primarily for manufacturing operations, in many of which two cuts can advantageously be taken at the same time, or, first a roughing cut and then a finishing cut, or two cuts of different character at the same setting.

The engraving shows the construction of the machine so clearly that little need be said in explanation of its method of operation.

The cross-rail upon which the two spindle saddles are fitted extends out 15″ from the face of the column. It is 10″ wide (from top to bottom) and 36″ long, and the spindles can be set any distance apart from 10″ to 30″. The spindles have also $1\frac{1}{2}$″ independent vertical adjustment, while the vertical movement of the knee is 13″.

The platen is 16″ wide, 49″ long, has power feed of 44″ in either direction parallel with its length, and 18″ to or from face of the column. It has 30″ bearing in the saddle. The lengthwise feed is by means of helical gears and screw, the motion being powerful and steady. At the left hand is a crank, one revolution of which moves the platen half an inch.

The knee extends 30″ from face of column, is 16″ wide at top, and has a bearing upon the column 18″ wide. The elevating screw for the knee is as nearly as possible under the center of gravity of the weight.

The driving pulleys on spindles are 9″x3″, and have internal gears which can be thrown in when wanted, these reducing the speed in the ratio of $3\frac{3}{4}$ to 1, the speed ranging from 25 to 400 revolutions per minute, and the feed from .012″ to 1.8″ per revolution of spindles. Feed motion is derived from the tightener pulley at the center, an open and a crossed belt running from this to a double friction clutch pulley outside by means of which the feed is reversed. The machine weighs about 3,500 pounds. It is built by the Fox Machine Company, Grand Rapids, Mich.

Spain appears to be forging ahead in the industrial world. The railway system is being greatly extended. The mining industry appears to be developing, both as regards coal and iron and other ores. The production of iron is increasing, while even in the textile trade our Manchester correspondent points out that Barcelona houses are cutting Lancashire manufactures out of the Cuban markets. This last is in a great measure due to a preferential duty, but it is pointed out that the modern mills in the Barcelona district are all equipped with the best machinery—mostly of Lancashire manufacture. —*Industries and Iron*, (London).

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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$4.00 a year to Other Countries, postage prepaid.

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Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

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Publishers' Agents, New York.
DEALERS SUPPLIED BY
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The American News Company, New York, N. Y.
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, OCTOBER 26, 1893.

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Headquarters at the Fair.

During the continuance of the Chicago Exposition the AMERICAN MACHINIST will have its headquarters in the space allotted to the Mechanical Press in Machinery Hall. The exact location is Section No. 27, Column K 37. Word can be left with the attendant there by any one who is desirous of meeting a representative of this paper, who may at the time be engaged elsewhere on the grounds. As the majority of our friends who visit Chicago during the continuance of the Fair will spend a considerable portion of their time in Machinery Hall, we invite them to make use of our facilities there by having their mail addressed in our care as above, where it will be cared for and delivered on demand either by our own representative or by the person who cares for the space in which our desk is located.

William T. Nicholson.

William T. Nicholson, founder of the Nicholson File Co., died at his home in Providence, R I, on the morning of October 17th. Mr. Nicholson was born in Pawtucket, R. I., March 22, 1834. At the early age of 14 he began an apprenticeship in the machine shop of Paul Whitin & Sons, at Whitinsville, Mass. Soon after the conclusion of his apprenticeship he went to Providence, R. I., where he followed his trade, being for some time foreman for Brown & Sharpe, of that city. After his connection with this firm he engaged in business for himself, first with Mr. Brownell in the manufacture of jewelers' tools and other light machinery, and afterwards by himself. Later on, at the beginning of the war, he manufactured machinery for the government, used in gun making. Having devised special tools used in the production of small parts of rifles, he also engaged, with Mr. Monroe, in the manufacture of these parts, this business being separate from his machine shop, which he continued to operate. In 1864 he sold out his part of the gun business, and gave his whole attention to the machine shop and to the perfection of a machine for cutting files, upon which he had been at work for some time. This he soon accomplished; the outcome of his inventions in file making being the present Nicholson File Co., of which he was president. Here he found plenty of hard work in devising and perfecting other machinery used in the manufacture of files, and in building up a trade in the files produced, there being at the time a decided prejudice against machine cut files. How well he succeeded, the present works of the company—covering about four acres of ground—testify.

In his early machine shop life, Mr. Nicholson saw the need of a mechanical education, and assiduously devoted his evenings to the study of mechanics, mechanical drawing, etc. The knowledge gained in this way was of immense advantage to him later on, and particularly to the Nicholson File Company.

Mr. Nicholson was quiet and unassuming, liked by those who knew him, and intensely devoted to the interests of the company, working as earnestly as ever the last week of his life, his death being from apoplexy after an illness of only a few hours. He was much interested in the Providence Public Library, having been a trustee since its organization, and later its treasurer. He was also a director of the Rhode Island National Bank, the Narragansett Electric Light Co., and served the city for several years as councilman and alderman, although he took no active part in politics. He was much interested in the terminal facilities of Providence, was a member of the Board of Trade, and of the American Society of Mechanical Engineers.

Invincible Projectiles and Indestructible Armor Plates.

Naval officers are, as our readers know, devoting considerable attention to tests of projectiles and of armor plates, and as we have before remarked, these tests seem to show some very remarkable results; and one who, though not studying them deeply, yet pays some attention to the matter published about them, is very likely to get the idea that armor plate is made which no projectile can possibly pierce, while on the other hand there are projectiles made which no armor plate can possibly resist, which is, we suppose, about equivalent to saying that the "irresistible force" has at last "met the immovable body." Somehow, though it may be very unreasonable in us of course, we have come to think that whether an armor plate shall be "pierced like cheese," with "scarcely perceptible injury to the projectile," or whether, on the other hand, the projectile shall be shattered to atoms while the plate is scarcely marked, depends upon whether at the time it is projectiles or armor plates that are being tested. If it is a test of projectiles we somehow expect that the plates used as targets will be easily made to resemble porous plasters; but this counts for nothing against the plates, because, you see, it is projectiles and not plates that are being tested. But when plates are to be tested, then the best obtainable foreign or domestic projectiles simply shatter themselves to pieces in the vain attempt to make an impression upon those plates, but this counts for nothing against the projectiles, because, you see, their invincibility has been established by other tests, and in this case it is only the plates that are being tested.

Professor Reuleaux Probably Meant It.

During the engineering congress at Chicago last August, Professor Reuleaux paid a very high compliment to American mechanics in respect to their practice of devising the means for and making very refined measurements in machine construction. He virtually said that they surpassed the world in this respect, a statement which most of those acquainted with the machine shops of the world will readily indorse. But this statement coming from such an authority seems to hurt some of our transatlantic brethren, and strenuous efforts are being made to explain, qualify, and modify Professor Reuleaux's words. But we believe Professor Reuleaux knew just what he wanted to say, and said it better than any other can say it for him. We are not of those who believe that we Americans are and of necessity must be superior in every respect as mechanics to the mechanics found in foreign countries. But we have our specially strong points, and among them is this one of the development and general use of refined methods and instruments for measurements. It is now rather the exception to find a good machinist in this country who does not make free use of the micrometer caliper, and a large proportion of them have their own micrometer calipers as part of their kits. And our micrometer calipers are sold in most other machinery building countries as the best article of the kind obtainable for general use.

Marking Eccentrics.

At a gathering of railroad men not long since, a master mechanic of a prominent road in discussing the question of keying *vs.* set screws for locomotive eccentrics, said that he once knew of a case in which a new engineer, who came highly recommended, proposed, the first thing, to forestall any possible trouble with slipped eccentrics, and went under his engine with hammer and cold chisel and made a mark at the side of each eccentric extending over onto the strap. He went out on the road, and one of the first things to happen him was to slip an eccentric. He went under to find out by his marks which one it was, and to his surprise found none of the marks agreeing, and supposing all the eccentrics had slipped, he set them all to make the marks agree, and had an example of the most wonderful steam distribution ever known—or would have had if he could have got the engine to move.

The Buckeye Engine Company, so far as we know, inaugurated the use of the return pipe with a hollow ball at the end for oiling the crank pins of steam engines. In the instance of the engine exhibited at the Centennial by this firm, that round ball at the end of the return pipe ran as truly as if turned in place. This plan of providing for oiling has been very extensively employed since that time and a large number of the engines at the Fair are provided with it, in all of which the ball "runs out" anywhere from one-eighth to one-quarter of an inch. They serve their purpose just as well but they do not look as well by a long way.

It is said that manufacturers of jewelry in Providence and Attleboro are much dissatisfied regarding awards given at the Exposition, the cause of complaint seeming to be that so many manufacturers have been given medals that they are practically without commercial value. It was to be expected either that most or quite all exhibitors would secure medals, or that those failing to secure them would be easily able to demonstrate that they ought to have done so.

Joseph P. Mullins, known to many of our readers, has accepted the position of General Mechanical Manager for the Beckett Foundry and Machine Company, of New York and Arlington, N. J.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(524) D. M., San Francisco, Cal., writes: Please inform me where I can obtain Walker's chart for determining the form of teeth of gears. *A.*—Write to Joseph Walker, Vice-President and General Manager, Walker Manufacturing Co., Cleveland, Ohio.

(525) C. J. C., South Bend, Ind., writes: Please inform me if there is such a thing manufactured as a mineral rod, or magnet of any kind, by which gold or silver can be located and discovered. *A.*—We have not heard of such a thing, and believe there is none.

(526) L. J. R., Meadville, Pa., writes: Please inform me how to make a cheap ejector that will lift water out of a well 20 feet deep. *A.*—It is doubtful whether you can make one cheaper than you can buy; at any rate the designs of these ejectors now on the market are about as simple as they can be made; and sectional views of these with principal dimensions for a given capacity you can obtain in catalogues from the makers, these will assist in making the design, should you still insist on making one.

(527) J. B. J., Bury, England, writes: I should be pleased to learn through the medium of your paper the names of makers of dynamometers capable of indicating up to 100 horse-power. I wish the meter to be applied to a pulley about three feet diameter, making from 250 to 350 revolutions per minute, and if it be possible to attach a recorder to give a continuous diagram of the varying power, it would be much more valuable for my purpose. *A.*—A very convenient and reliable dynamometer is made by F. Van Winkle, 126 Liberty street, New York. A recorder to give a continuous diagram can be readily attached.

(528) W. R., New York, asks: What is gained by using a condensing engine in place of a non-condensing engine? *A.*—In a non-condensing engine, the steam pressure on the piston has to overcome, besides the resistance due to the work to be performed, the resistance due to atmospheric pressure; in condensing engines the resistance due to atmospheric pressure is reduced nearly to nothing, hence the back pressure on the piston in a condensing engine is from 10 to 12 pounds per square inch less than in a non-condensing engine. Again, if the condensing engine is provided with a surface condenser the water due to condensation is fed back into the boiler, and this water being comparatively pure will prolong, in many cases, the life of a boiler, and will also be conductive to economy of fuel.

(529) W. G. H., Kalamazoo, Mich., writes: Kindly inform me which you consider the best practical text-book of mechanical drawing and designing suitable for beginners. *A.*—There are several good books to choose from. The Practical Draftsman's Book of Industrial Design, published by Henry Carey Baird & Co., of Philadelphia, Pa.; Machine Drawing and Design, by W. Ripper, published by D. Van Nostrand Company, New York; Mechanical Drawing, by C. W. MacCord, published by John Wiley & Sons, New York; Simple Lessons in Drawing for the Shop, by O. H. Reynolds, is an excellent little book for its price (50 cents), it is published by Debs Publishing Company, Terre Haute, Ind. The papers on practical drawing which appeared in our columns were written for beginners.

(530) J. J., Toronto, Canada, writes: Please give me the size for an upright boiler for an engine with a cylinder 1¼ inches diameter and 2½ inches stroke, also size and number of flues and size of safety valve. *A*—Diameter of outside of shell of boiler 16 inches; height of shell, 32 inches; diameter of furnace, 10¾ inches; height of furnace, 18 inches; diameter of flue, 3¾ inches. You will not require any tubes in a boiler as small as this one, a plain upright as here given will answer every purpose. Size of safety valve, ¾ inch. 2. Please give me the horse-power of an engine with cylinder 2½ inches in diameter and 5 inches stroke, mean effective steam pressure 30 pounds. *A.*—One-half horse-power non-condensing. 3. What should be the weight of fly-wheel for this engine? *A.*—About 65 pounds.

(531) C. E. L., St. Joseph, Mo., writes: We have a locomotive in the shop to repair for which a pair of new cylinders and saddles were furnished; these are 4 inches higher than the old ones. What alterations would you advise to be made to get the valve motion square? *A.*—If your cylinders are 4 inches higher than the old ones, the steam chests are probably raised 4 inches also. Under these conditions you will have to lengthen the rocker arms, and you may also have to raise the rocker box, lifting shaft bearings, and it may require a new lifting shaft. It is impossible to point out all the alterations, or to what extent each of the different parts will have to be changed without having a general drawing of the engine. 2. Can you give me any correct method for laying out the link saddle? *A.*—Yes; see our issues of May 10, 17, 24 and 31, 1884.

(532) T. E., New York, writes: Please give the rule for finding the point of cut-off in a steam cylinder, the initial and terminal pressures being given. For instance, the initial pressure is 100 pounds, and the terminal pressure is eight pounds, at what point of the stroke should the cut off occur? *A.*—We presume that the above pressures are those indicated by the gauge, if so, add 14.7 pounds to each, which will give the absolute pressures. Divide the absolute initial pressure by the absolute terminal pressure, use this quotient for the denominator of a fraction whose numerator is 1, this will be the fractional part of the stroke at which steam should be cut off. In the example given we have $\frac{114.7}{22.7} = 5$, hence the steam should be cut off at $\frac{1}{5}$ of the stroke. The above result will be somewhat affected by the clearance, which we have neglected.

(533) F. W. S., New Haven, Conn., writes: I have met with the following problem and a solution of it but fail to comprehend the method or reason of solution. Kindly enlighten me. A bar of iron is 8 feet long, a hole is required to be drilled in it so that the bar may work as a lever upon a pin or stud, one end of the lever must move through a distance of 3 feet, and the other end through a distance of 2.5 feet; at what distance from either end must the hole be drilled? *A.*—The distances from the hole to the ends of the lever must have the same ratio as the distances through which the ends of the lever move. Hence assume the lever to be divided into $3 + 2.5 = 5.5$ parts; then each part will be $\frac{8}{5.5} = 1.4545$ feet long, and the hole must be placed at $1.4545 \times 2.5 = 3.6363$ feet from one end or $1.4545 \times 3 = 4.3636$ feet from the opposite end. The same result is obtained by the following proportion: 5.5 : 3 :: 8 : distance from end, which gives us 4.3636 feet; or 5.5 : 2.5 :: 8 : distance from the other end, which gives us 3.6363 feet.

(534) E. L. M., Elizabeth, N. J., writes: Please give me any information you can about making hydraulic cup leather packing. What kind of leather should be used, and how treated? Should the dies be hot or cold? I have been experimenting, but with partial success only. The cup generally bursts at the crown end of hat before getting deep enough. *A.*—For hydraulic packing of this kind, the best oak tanned sole leather should be used; soak it thoroughly in clean water over night, or longer if necessary, so as to make it soft and pliable. When in this condition it is placed in cast-iron forms, which are then slowly tightened, and the leather pressed to the required shape. It may be possible that more than one operation in different forms may be required. When, finally, the cup has the required shape, it should be dried in the form by a moderate heat, after which the cup is taken out and trimmed. After this it should be immersed in blood warm beef tallow, and when thoroughly soft the surface should be wiped off and the packing placed in recess prepared for it.

(535) W. C. D., Bellows Falls, Vt., writes: Inclosed please find pictures of a friction clutch which I have made to attach to the end of a calender roll to drive a train of seven rolls. It consists of a cylindrical shell, in which two shoes are pressed against the inner side of shell. Each one of these shoes has a surface of contact nearly equal to one-half the circumference of the shell. These shoes are pressed apart by nuts, with right and left-handed threads. These nuts are actuated by a lever connected to a sliding collar on the shaft. What I want to know is, if a single thread will wear any longer, and give less friction than a double or split thread? *A.*—If the pitch of the single thread is equal to that of the double thread, the latter will wear the longest; there will be no difference in the amount of friction in the two kinds of threads. 2. Would malleable cast-iron be as good as brass for the nuts? *A.*—We have no confidence in malleable iron for this purpose, we prefer to use brass nuts. 3. Is there any formula by which I can compute the horse-power which this clutch will transmit? *A.*—To find the horse-power which this clutch can transmit, we must know the pressure of the shoes against the cylindrical shell. According to the principle of virtual velocities, the pressure against the shell is to the pressure on the sliding collar as the axial velocity of the collar is to the axial velocity of the nut. Or, if P denotes the pressure in pounds against the shell; p the pressure in pounds on the sliding collar; V the axial velocity of the latter, and v the axial velocity of the nut, we have

$$P : p :: V : v.$$

In this case we may assume that about 60 per cent. of the pressure p is lost in friction, leaving only 40 per cent. for useful work. Hence, from the foregoing, we have

$$P = \frac{p \times V}{v} \times .40.$$

Having found the pressure P, the horse-power is found by the following formula:

$$\frac{2 \times P \times u \times c \times n}{33{,}000} = \text{horse-power},$$

in which u denotes the coefficient friction, which for cast-iron against cast-iron may be assumed to be .15; c the circumference in feet of the surfaces in contact, and n the number of revolutions per minute.

(536) S. T. W., Baltimore, Md., writes: A customer came to me with a blue-print to make a tracing from it. He wanted it for making a print with black lines on white ground. He remarked that there was a process by which the blue background could be bleached white and the white lines made black or dark. Can you inform me if there is such a process and how it is done? *A.*—There is no process by which the blue ground can be bleached white and the white lines made dark, but there is the nigrosine process by which black lines on white ground are at once produced. This process is similar to the blue process and nearly as simple, but it requires a chemical developer added to the water bath. You should be able to procure the paper prepared for this process and the required developer from dealers in artists' material in your city. 2. Some time ago I put up a Rider hot air engine in the country; we had to carry the smoke pipe about 18 or 20 feet over the cellar in a horizontal direction, and enter it into the pipe of the furnaces that heated the building. The chimney runs up considerably above the roof, the building is two stories high, a damper is in the pipe of the furnace. In the summer when there is no fire in the furnace, we can get no draft at the hot air engine; it takes about two hours to get it hot enough to run, with a hot fire in the engine. The smoke-pipe is perfectly cold near the chimney, and at points between engine and chimney water drops from the pipe, which is evidently condensation. I have not been there in the winter when the furnace is going, but they inform me that the draft is all right then. The chimney, stove pipe, etc., are clean and in good condition. Can you suggest a cause for this? *A.*—The draft of a chimney depends on the difference of temperature of the outer air and that of the gases passing through the chimney; the draft is stronger with a greater difference in these temperatures than with a lesser difference. Since, in summer, the difference is not as great as in winter, it must be expected that the draft cannot be as good in summer. The horizontal pipe leading to the chimney also tends to reduce the power of the chimney, and it may be that a higher chimney is required for the work imposed upon it. Probably the greatest trouble is that there is no damper for closing the communication between furnace and chimney. If there is no such damper have one put in, and close it when the furnace is not in use.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

6-Spindle Turret Drills. A. G. Quint, Hartford, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Air Compressors for every possible duty. Clayton Air Compressor Works, 43 Dey Street, N. Y.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Steam Pressure Regulators, Reducing Valves, Safety Checks Foster Engineer'g Co., Newark, N. J.

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"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Notes on Pattern Work.

BY I. WHITEHEAD.

HOW TO LEARN PATTERNMAKING.

When we consider patternmaking to consist in a knowledge of the best way to form and construct an infinite variety of shapes, ever treading upon new ground, it must be that all the patternmakers' past experience presenting the nearest conditions to the present problem is consulted, therefore the larger that store of experience the better prepared he is to do the work successfully.

1st. As a groundwork he must have a knowledge of the nature of the material and experience in working it.

2d. He must be able to read drawings quickly and accurately, and to transfer and develop them upon the surfaces of the material; in fact he must have a thorough knowledge of the principles of drawing.

3d. He must have as wide an experience as possible in the construction of the infinite variety of patterns with a knowledge of the subsequent molding.

The first two acquirements can be got while in most pattern shops with a study of drawing, but when we come to an experience in all the requirements for which patterns are made, one would have to work in as many shops as there are specialties. It would be practically impossible for one man to have extended experience in all its features, so we have workmen of the most limited as well as with the widest range of thought and experience; from the man who just learns to fill a place in one shop, in which the first requirement of use of tools alone was needed, and by imitation and instruction from the foreman makes the simplest kind of work; to the man who can walk alone leading into new paths, and who uses all the experience of his own and that which he has gained from others, to guide him to the best results.

I have told my pupils in the Technical College, as a fact for encouragement that, with the practice in the use of tools they received who gave their whole minds to it for the time being, together with the practice and instruction I gave them in pattern work, they would be able to work in a shop and rank equal to one third the men at present in the business with an assurance that their knowledge of drawing would enable them to rise with added experience.

Practical experience is the developing field of the patternmaker, who must be always learning, not confining himself to his own experience, but using his eyes to see what others are doing not only in his own shop but everywhere where his trade is practiced. When we leave one shop and go to work in another we always find some special features adopted through extended experience in their class of patterns. These are points which the AMERICAN MACHINIST specially invites and publishes for the benefit of such workmen as the stationary patternmaker. No workman whose experience is confined to one shop can be counted a first-class patternmaker in this age of specialties, so that the trade calls for a constant exchange of ideas to develop a full workman. With this preface I offer a few general notes in regard to pattern work.

USES OF SHELLAC.

Accuracy or truth to the size required and that it will remain so is one of the most important elements of a pattern. One workman lays too much importance upon the fine finish of some patterns by not discriminating as to the utility of that quality upon that particular work. Another says he prefers the clear varnish finish because it shows the quality of the work, while another claims that lamp-black makes a harder coat and answers somewhat as a body of filling as well. To have the black varnish smooth it requires to be put through a fine metal strainer. Though varnish is generally considered purely for finish I have met with foremen, in the case of small work, that have talked of a thick coat to make the casting heavier. A more practical illustration of the use of shellac for this purpose or rather when the pattern is finished and the designer fancies or judges that it would be better to add a little to the surface (which is a common occurrence in a certain class of work) to strengthen a curved arm or connection is as follows: Take a quantity of the shellac in the flake, wrap it in a cloth and boil it in water, and then while hot work it in the hands forming it into sticks like sealing wax. Thus prepared it can be applied to the part you wish to strengthen with a hot iron, and burnished or shaped with the same. When cold the part can be finished with plane, spokeshave or scraper, making a hard smooth surface that will not peel or change, and is immediately permanent.

In one large shop I found they used shellac varnish of a fair consistency for the purpose of glue in the building up of segment work, the object being to withstand the action of the hot moist sand in molding—which melts glue in joints, thus making a rough surface and causing loss of adhesive strength at the joints. The segments keep their shape better, and the moisture cannot enter the wood. Of course during construction nails or wood pegs have to be used.

CORNER FILLETS.

There are corners where wood fillets are best adapted by leaving the feather edge thick enough to let into the wood below the surface, such as flanges on turned work or loose flanges in straight work or in the most permanent intersections with the main body in standard work. Lead and leather fillets have each their advantages in many places as cheaper but disadvantages in a question of permanence. Putty is very generally used in core-boxes of a winding character, and for nail holes in large patterns because of its cheapness and the ease with which it can be shaped with a burnisher. In cases like locomotive core-boxes it is commonly used. Beeswax is used largely for small hollows in patterns and for nail holes, as it easily produces a nice smooth finish.

I mention each in its application to show

that there is no one best fillet or best material; each is best in certain places and the patternmaker should have experience with all that he may judge the best to use for certain conditions.

PATTERN MATERIAL.

Soft and straight-grained pine is the choice for most patterns, because of its cheapness, and because it keeps its shape well and is easy to work, but for small patterns and for parts of large patterns where there is much wear, mahogany or cherry is most generally used. White metal finishes and solders easily, while brass is harder, stronger and smoother. Cast-iron will not easily strain out of shape, is stiffer, for stove plate work, for instance. When a great number of small castings are required they are soldered or jointed together on a spray or gate. Rubber is also coming into favor for a certain class of patterns, and I for one was much interested to learn through the AMERICAN MACHINIST the nature and extent of its application, because each material has its peculiar advantages for certain patterns. The extent that plaster of paris can be used as a mold for several castings is very limited, but it is commonly used to make follow boards on which very light and crooked patterns may be rammed up and parted.

WOOD MOLDS.

I have made a number of wood molds for casting lead keels of boats where the section matching the lines of boat were in size about 3 feet wide and 2½ feet deep. I first constructed a frame of, say, 6″x2″ at a distance of one foot apart, shaping out the inside of frame or ribs to the shape of the section at that plane, and so on throughout the length of the mold, then lining the inside with strips or boards that would easily bend to the varying shape, and nailing them down, just the reverse action to the ribs and planking of a boat. With care in shaping the frame inside allowing the thickness of planking intended to be used, very slight dressing to face up the inside to the shape is needed. These molds were washed with a thick coat of plaster of paris which when dry was smoothed, leaving about $\frac{1}{16}$″ of plaster all over the inside. The mold was then rammed up in sand all round so as to sustain the pressure of metal on the sides. Thus the air was prevented from feeding the burning of the wood which is turned by the hot metal into a firm charcoal as far as it burns, thus keeping the form perfect while the coating of plaster gives a smooth surface to the metal. In this case there was but one casting required from each mold, but it might be possible in some cases where it would be an advantage, to line the inside with some fire proof material, or to saturate the inside so that it would withstand the destruction by low fusing metals. We tried asbestos, but it required the greatest care, or the metal would get under the paper and so spoil the casting as well as the mold.

SANDPAPERING.

In sandpapering pine I think it a good plan to chalk over the surface of the wood to be papered as it keeps the sandpaper from gumming up, and so it will cut keener, lasts longer, and levels off the plane marks quicker.

The attendance at the Fair on "Manhattan day" was 290,000.

Blowing Engines.*

By Julian Kennedy, Pittsburgh, Pa.

The different types of blowing engines in use are so numerous that it would not be practicable to consider them all in this paper. I shall therefore only take up briefly a few well known types.

The style of blowing engine most largely used in this country is the vertical engine with air cylinder above, crosshead between steam and air cylinders, and two fly-wheels,

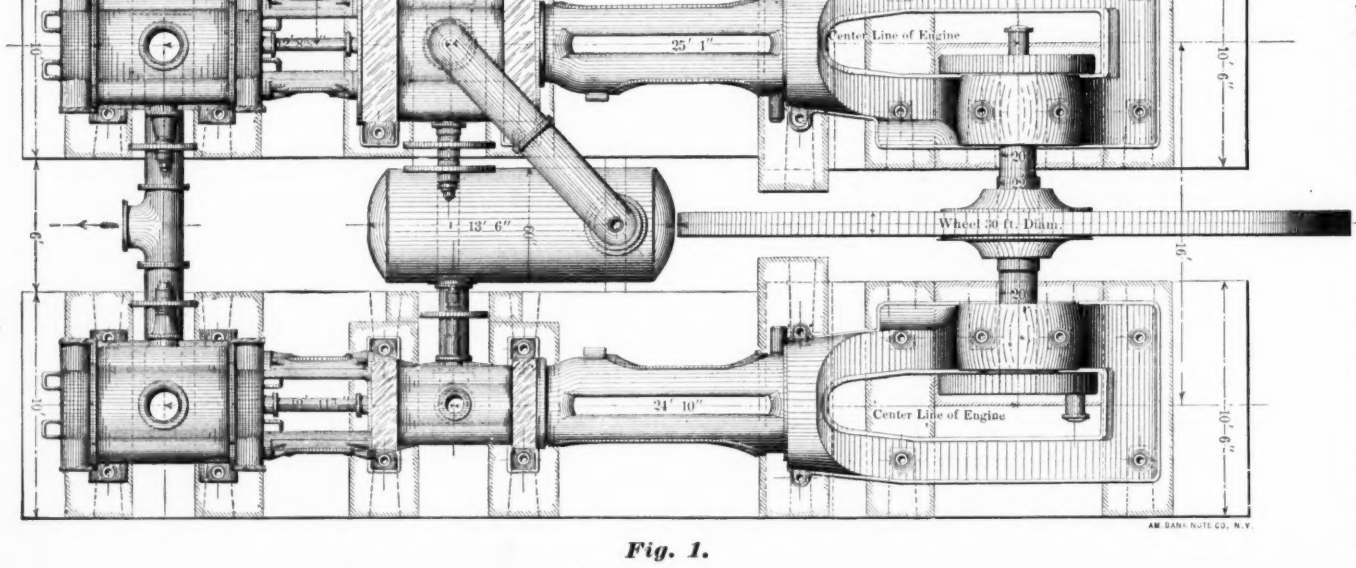


Fig. 1.

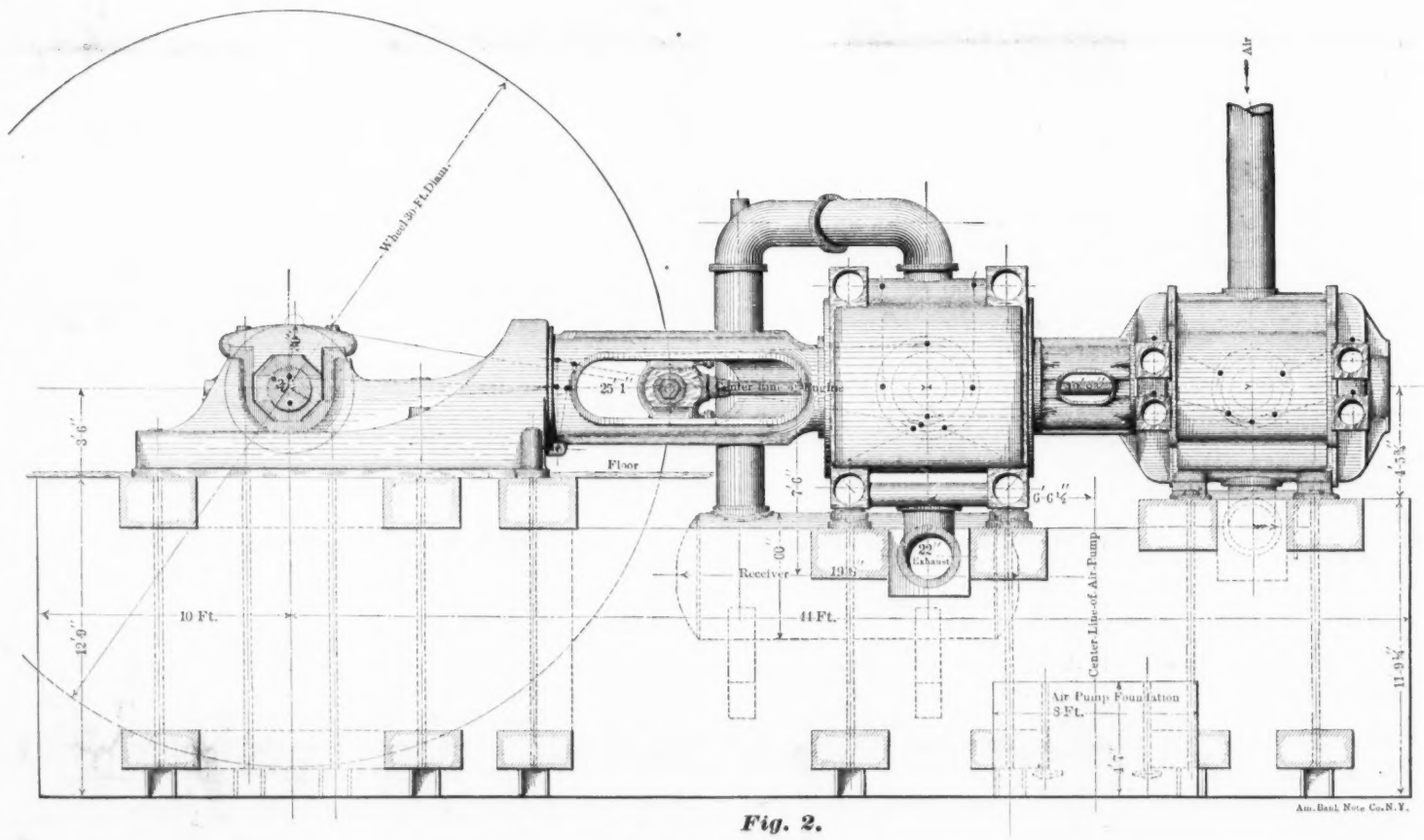


Fig. 2.

BLOWING ENGINES.

much weight is often given to this consideration. With machines strongly proportioned and carefully built, there should be very few stops; on the other hand, in the case of Bessemer engines, which are starting and stopping at short intervals, the fact that one attendant can handle the double machine is worthy of consideration.

The double-coupled type of engine is also particularly adapted to compounding. As most blowing engines run under a comparatively constant load, and as the increasing use of water tube boilers in iron and steel works renders it easy to maintain high steam pressures, I have no doubt that each having a wrist-pin in its hub, or in one arm. This kind of engine can be built cheaply, takes up little room, and is very accessible. Its disadvantages are that the crosshead is liable to break, and that putting the wrist-pins in the wheels tends to set up vibrations in them. It is likely that on the whole this type of engine will continue to be built quite extensively.

The same general arrangement has also been used to some extent, but not widely, in horizontal engines. The Bethlehem Iron Company has some very fine blowing engines of this type, except that they are compound, having the one steam cylinder replaced by two, side by side. These engines are noticeable not only for the very excellent workmanship on them, but also on account of the weight of the pistons being carried by steam pressure applied in chambers in the lower side, the steam being supplied to these chambers through the hollow piston rods. This arrangement, I believe, has always worked well.

Another type of engine which has given good satisfaction is the vertical double engine, having air cylinders above, steam cylinders below them, and cranks at bottom, the engines being coupled to cranks on the ends of the shaft, placed at right angles to each other, the shaft carrying the fly-wheel at its center. Engines of this type, except that they are arranged horizontally, are also used to a considerable extent. These engines avoid the disadvantage of having wrist-pins in the fly-wheels, and also dispense with the long crosshead with its attendant disadvantages. They give a very uniform pressure of blast, and are very convenient for starting. The vertical engines of this type, as compared with the horizontal, take up less room, and the wear on cylinders, due to carrying the weight of pistons, is avoided. On the other hand, the machine is very high, and there is considerable vibration. The horizontal machine avoids this, is very accessible, and is cheaper to construct. With proper attention, there seems to be no serious trouble with wearing of cylinders, so that wherever ground room is ample, the horizontal double-coupled engine seems to be very suitable. The principal objection urged against this style of engine is that in the event of a break a large machine is disabled, whereas, if two single engines are used, one can keep the works going while the other is being repaired. This is doubtless correct; but I think that too

* A paper read before the Mining Engineering Division of the World's Engineering Congress at Chicago.

before long compound blowing engines will be adopted in a large majority of the new plants built.

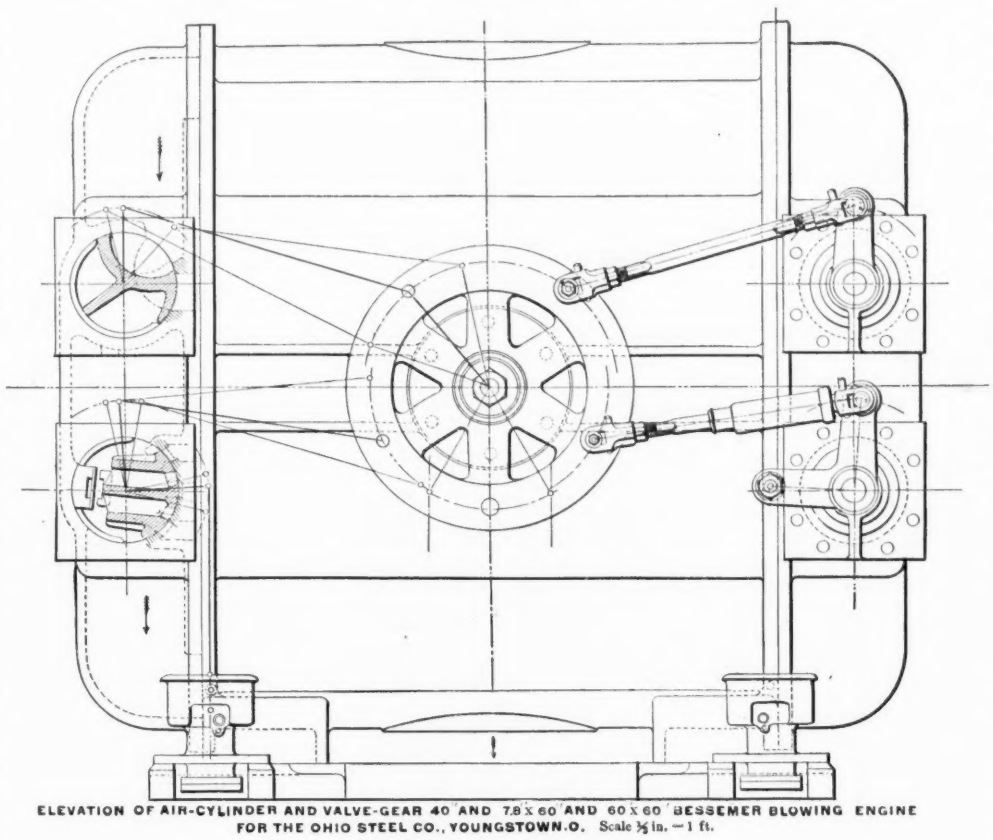
In looking over the different kinds of blowing engines, we cannot fail to be impressed with the fact that, in nearly every case, the air valves are the weak point in the machine. In the great majority of cases the maximum speed of the engine is about half what it could be, if the air valves could work fast enough. To remedy this fault, several plans have been resorted to. In some cases fairly good results have been obtained by making the valves very light, giving them but little lift, and arranging them so that they shall seat by gravity. In some cases valves of this kind are so constructed that the air in entering the cylinder is compelled to pass through a large number of very small openings. This is a very objectionable arrangement, not only on account of the increased amount of friction, but because the air in passing over the metal grids in thin streams will absorb quite a considerable amount of heat from the heads, which, in the case of engines working against high blast pressures, are made very hot by the heat of compression.

This heating of the incoming air expands it, and proportionally reduces the weight of air entering the cylinder at each stroke. I have observed this in the case of an engine, which was so constructed as to cause the air to travel about three inches over the hot metal in thin films $\frac{3}{16}$ inch thick. Alongside of it was another engine of the same size and make, except that valves were used which allowed the air to pass over about one inch of metal, the openings being of such size that each stream of air was two inches in thickness. Careful and repeated tests of these engines, when both were in good order, showed that, while the indicator diagrams were practically the same, the one with the large valves would burn about 10 per cent. more coke in the furnace, a result which could only be explained on the supposition that, in the case of the engine with small air openings, the incoming air, in passing through the small and tortuous passages in the heads, was heated about 25 degrees C. more than in the case of the other engine. It is plain, therefore, that a blowing engine should have air valves which will not only give ample area of inlet passage, but give this in a small number of good-sized openings.

Figs. 1 and 2 are the plan and elevation, and Fig. 3 is the diagram of air valves and valve gear, of a compound horizontal blowing engine, now being constructed by the well-known builders, the E. P. Allis Company, for the Ohio Steel Company. The engine is a Reynolds-Corliss cross compound; steam cylinders, 40 inches by 78 inches; air cylinders, 60 inches; stroke, 60 inches, with reheater in intermediate receiver, and is provided with an independent condenser. In general design this engine, as will be seen at a glance, is very similar to the large quadruple-expansion engine by the same builders to be seen at the Exposition. The air cylinders are so arranged as to draw the air through pipes, which project above the roof of the building, and to discharge it below the cylinders.

The inlet valve is a plain rotary valve held to its seat by the blast pressure, which is admitted to the back of the valve by a port from the discharge chamber, and is driven from a wrist-plate. The outlet valve, as will be noticed, is a triple-ported valve, which is closed at the proper time by the wrist-plate.

The connection between wrist-plate and valve is made by a telescopic extensible rod, which pushes the valve shut, but permits the wrist-plate to reverse its motion without pulling the valve open. To the valve lever is attached a vacuum pot, which tends to pull the valve open. When the valve has been closed it is gripped by the receiver pressure acting on the back, holding it against the seat, and remains stationary during the return stroke of the piston, and also while the piston advances towards it again, until it has compressed the air in the cylinder to nearly the same pressure as in the receiver, at which time the pressure on the back of the valve becomes so nearly balanced that the vacuum pot can move the valve, which is then quickly thrown open. The telescopic connecting rod is so constructed that a small dash-pot is formed at the bottom of the tube, to avoid shock should the plunger strike the bottom while the valve is opening, or when the closing motion begins. It will be observed that no trip or releasing gear of any kind is used with these valves, the holding and releasing being done by friction, controlled in the simplest possible manner by the air pressure in receiver and cylinder. The outlet valves are also held against their seats by long flat springs bearing in the center on the back of the valve, and at ends on blocks set inpockets at end of the valve. It will be seen from the drawings that these blocks have a clearance of $\frac{1}{4}$ inch at the bottom, so that if for any cause the valve should be prevented from opening at the proper time, it will be only forced back from the seat, the opening of $\frac{1}{4}$ inch being sufficient to allow the engine to run at full speed with wrist-plate and vacuum pot disconnected from outlet valves. This valve gear is extremely simple, and practical tests have shown it to work admirably. This engine is intended to run at a speed of 60 turns per minute if necessary.



ELEVATION OF AIR-CYLINDER AND VALVE-GEAR 40 AND 78 X 60 AND 60 X 60 BESSEMER BLOWING ENGINE FOR THE OHIO STEEL CO., YOUNGSTOWN, O. Scale ⅛ in. = 1 ft.

Fig. 3.—Blowing Engines.

In conclusion, the tendency in designing blowing engines seems to be in the following directions:

1st. Compounding.

2d. Obtaining valve gear which will give liberal openings at both inlet and outlet, and which can be operated at a fairly rapid speed.

The latter advantage can probably be best secured by the use of metal valves operated as far as possible positively, which will also do away with the vexation due to the use of leather, gum and other short-lived materials.

Chains for Transmission of Power.

As most of our readers probably know, they in England make much more use of chains for transmitting power than we do here, and one reason for this may be that they have superior chains. However this may be, it will be instructive, no doubt, to consider some of the forms of chains made by a leading manufacturer of Manchester, Mr. Hans Renold.

The first of these, Fig. 1, is a chain intended for high speed transmission. The main distinguishing feature of this chain is the fact that, while it is what is called a roller chain it imposes no wear whatever upon the holes which pass through the thin side links where the small bearing surface causes excessive wear. Five differently formed pieces enter into the construction of this chain; there are two different kinds of side links; a solid pivot which is riveted at both ends to the outside links; a pivot bearing sleeve which is riveted at both ends to the inside links, and has a hole through it in which the pivot works; and, finally, the roller which fits over and is free to turn upon the sleeve or pivot bearing. The part sectional view shows the pivot bearing as though it were made solid with one of the inside links, but this, we believe, is not correct.

Fig. 2 is another form of high speed chain which is composed of only three different pieces. In this chain the inner link is a solid steel block which is drilled for the pivots, and between the pivot holes is a third hole, as shown, which is filled with felt, that forms an oil pad that is always in contact

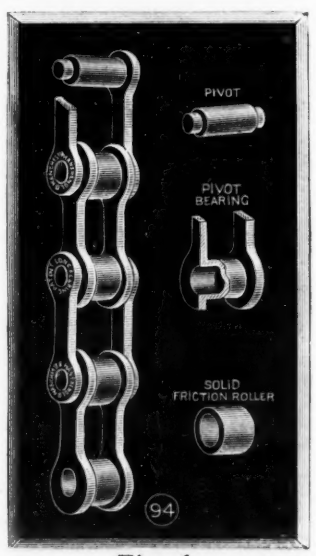


Fig. 1.

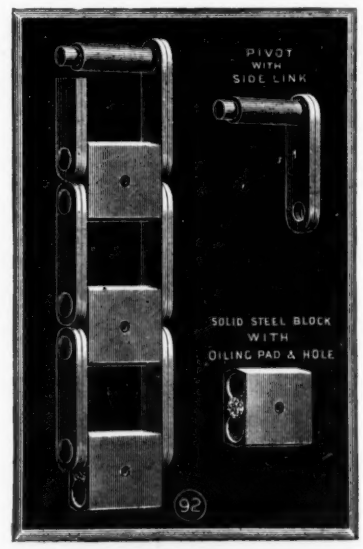


Fig. 2.

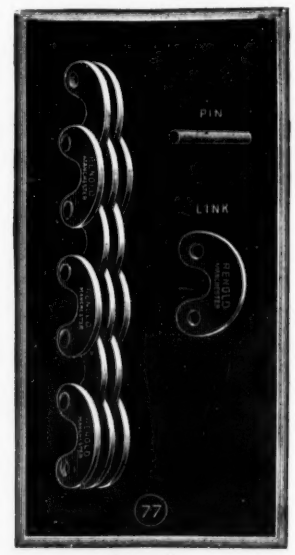


Fig. 3.

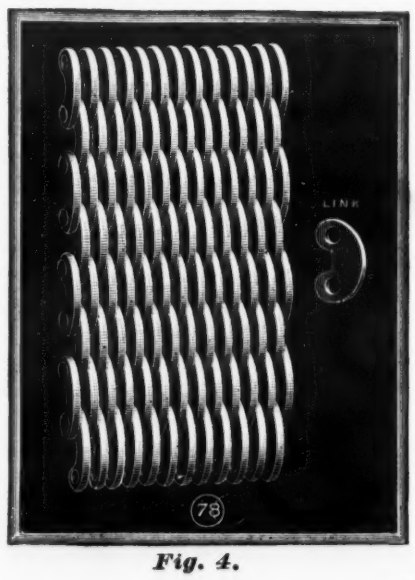


Fig. 4.

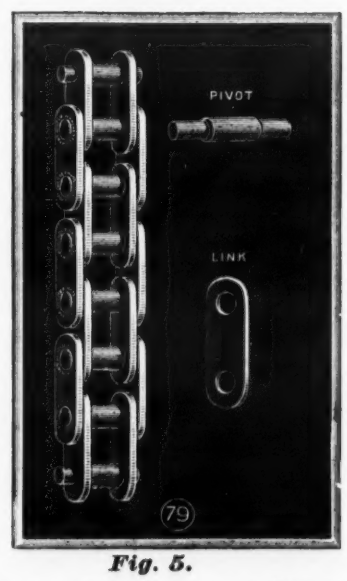


Fig. 5.

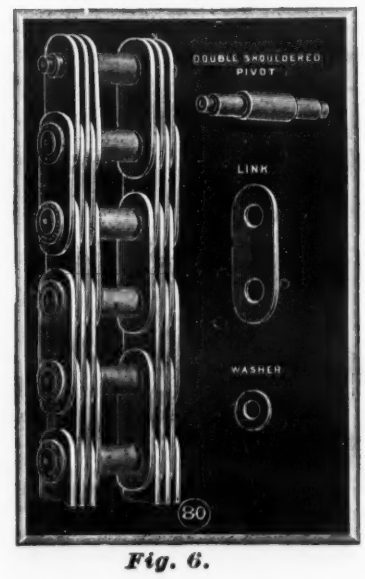


Fig. 6.

Chains for Transmission of Power.

with the pivots. An oil hole is provided, as shown. In this chain there is also, as will be perceived, a large bearing surface, with provision for constant lubrication.

In this country, what is essentially the same chain is patented by and has been made for some years by Stirling Elliott and used on his "Hickory" bicycles, it being also used under license for the past few years on the Pope Mfg. Co.'s "Columbia" machines. In both these chains hardened steel parts are used, and great care is taken in their manufacture, so that with properly made wheels no difficulty is experienced in running them at a speed of 1,000 feet per minute, and in some cases they are running satisfactorily at 1,500 feet. Great stress is, however, laid upon the matter of suitable wheels, Mr. Renold even going so far as to refuse to fill a first order unless the wheels are also supplied.

For speeds of 100 feet or under per minute, the chains used are shown in Figs. 3 and 4, the construction of which will be readily understood. These can be made of almost any desired width, and are especially fitted for use with pinions of very small diameter, and are not recommended for wheels of large diameter.

Chains suitable for lifting or very slow driving are shown by Figs. 5 and 6, these being called stud chains. These are used in connection with hoists, etc., and for wheels having 7 to 21 teeth. Any required number of links can be used to make up the required strength, and in fact, a greater number of thin links is recommended for safety rather than fewer links of greater thickness.

A great variety of chains for a great variety of purposes are illustrated in Mr. Renold's pamphlets, and he also publishes a small treatise upon "Roller Chain Gears," in which the theory and practice of chain and chain wheel making are discussed. In this treatise the conclusion is reached that for a roller chain both the sprocket wheels over which it runs should have the spaces between the teeth considerably wider than is required to enable the rollers to merely enter and leave, and much wider than is the common practice, and that the pitch of the driven wheel only should equal that of the chain, that of the driver being recommended to be considerably greater, a construction which is made possible by the extra width of space as mentioned above

Scotch Shipbuilding During September.

No features of interest call for record in reviewing the month's shipbuilding trade, and few reliable signs of improvement are discernible. The production is much about the average, notwithstanding the lock-out of joiners and carpenters, but the aggregate of the new work is nothing like what is necessary to keep all the yards going. Orders for a few vessels—of a class, too, decidedly better than the common run—were placed, but unfortunately at figures which a year ago would hardly have been looked at by builders. Scotch shipbuilders launched 19 vessels of 18,565 tons, of which 10, of 5,965 tons, were steamers, and nine, of 12,600 tons, sailing vessels. To the total the Clyde contributed 10 steamers, of 5,965 tons, and eight sailing vessels, of 11,300 tons; and the Tay, a sailing vessel of 1,300 tons. Of the steamers, one was between 3,000 and 4,000 tons, one between 500 and 1 000, and eight under 500 tons. Three sailing vessels were between 2,000 and 3,000 tons, four between 1,000 and 2,000, and two cargo flats, each of 100 tons. Three of the steamers, 5,134 tons, were screw steamers; four, 546 tons, fishing vessels; one, 99 tons, a paddle steamer; and two, 186 tons, stern wheelers. The vessels launched included only one or two of more than average importance. Messrs. Stephen, Linthouse completed the second of the three large steamers they were instructed to build for the Chesapeake & Ohio Steamship Company's new Atlantic service; Messrs. Scott & Co., Greenock, a steamer, of 850 tons, for Messrs. J. & J. Denholm, of the same port; Messrs. Henderson & Co., Meadowside, a large sailing ship, of 2,350 tons, for Messrs. John Hardie & Co, Glasgow; Messrs. Russell & Co., Port Glasgow and Greenock, a sailing vessel, of 2,250 tons, for Messrs. Andrew Weir & Co., Glasgow; Messrs. Barclay, Curle & Co, Limited, Whiteinch, a steel sailing ship, of 2,050 tons, for Messrs. Watson Brothers, Glasgow; and Messrs. Alexander Stephen & Sons, Dundee, a steel bark, of 1,300 tons, for Messrs. Brownells & Co., Liverpool. Of the total tonnage, 3,884 were for London, 1,300 for Liverpool, 545 for other English ports, 400 for Dublin, 11,950 for Clyde ports, 100 for Montrose, and 386 for India. The Clyde proportion is 17,265 tons, made up of 10 steamers, of 5,965 tons, and eight sailing ships, of 11,300 tons. To the total Partick and Whiteinch contributed 4,400 tons, Govan 4,530, Paisley 635, Bowling 100, and Port-Glasgow and Greenock, 7,550. The sailing tonnage is, it will be observed, greatly in excess of the steam—in these days rather an unusual feature.—*The Mechanical World.*

MANUFACTURES

The Rider Engine Works, at Walden, N. Y., has started.

Geo. Simon will erect a machine shop at New Iberia, La.

Henry Cromwell, of Cynthiana, Ky., will rebuild his machine shop.

Warder, Bushnell & Glessner are erecting a new foundry at Lagonda, Pa.

The Bass Car Wheel Foundry, of Memphis, Tenn., is building a large addition.

The car shops of the B. & M. R. R., Pittsfield, Mass., are running nine hours a day.

The Southern Foundry and Machine Works, of Fredericksburg, Va., has started on full time.

The saw-mill of T. V. Brown, at Redfield, Ark., was recently destroyed by fire. He will rebuild.

The Granite iron rolling-mills of the St. Louis Stamping Company are running on full time.

The Christopher Double Power Rotary Engine Company, Spartanburg, N. C., has been organized.

Furnace No. 2 of the Reading (Pa.) has been put into operation, giving employment to 75 hands.

The Norwich Shook and Lumber Company's steam-mill at Norwich, Vt., has been destroyed by fire.

The South steel mills of the Lackawanna Company, Scranton, Pa., have resumed work, employing 800 men.

The Stirling Company, 74 Cortlandt street, New York, report several recent sales of the Stirling water tube boiler.

The Cardwell Machine Company, Richmond, Va., will build a new mill costing $100,000 and covering 166x220 feet.

Caton Foundry and Machine Company, San Jose, Cal., has incorporated. Capital stock, $50 000. F. T. Caton and others are interested.

The Penberthy Injector Co., Detroit, Mich., inform us that they have been awarded the medal of merit for injectors by the Columbian Exposition

Webster & Perks Tool Company, Springfield, O., say: "We have just received notice that we have been awarded first prize on reducing wheel at the Fair."

The Lambertville (N J) Paper Company's mill has started up after several weeks' idleness. The Lambertville Spoke Manufacturing Company has also resumed work.

A corporation to be known as the United States Marine Signal Company has been organized at Kittery, Me., for the purpose of manufacturing an improved flag signal.

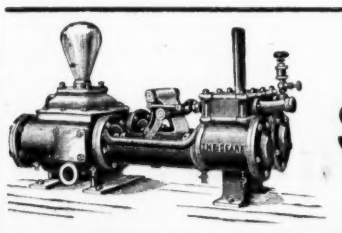
The Appleton Manufacturing Company, of Philadelphia, Pa., have issued a very finely illustrated catalogue of emery wheel and polishing machinery, of which they make a specialty.

The Connecticut River Lumber Company will cut more timber this winter than ever before; 100,000,000 feet will be hauled on to the ice in Connecticut Lake, and landed on the banks of that river.

The Field Engineering Company, 143 Liberty street, New York, have issued a large catalogue of vertical multi-cylinder steam engines made by the Lake Erie Engineering Works. The illustrations are very complete, and the typographical work is excellent.

The Berlin Iron Bridge Company, of East Berlin, Conn., have received the contract for the new drawbridge at Salem, Mass. The bridge will have a 60-foot opening with a roadway 28 feet wide in the clear, and two sidewalks, each 6 feet wide. It will be a deck plate girder construction.

Thomas Sully, Architect, of New Orleans, La., has ordered from the Berlin Iron Bridge Co., of East Berlin, Conn., an iron roof for a sugar house at Tampa, Fla. The building will be 60 feet in width, and 125 feet in length, the trusses being entirely of iron, covered with corrugated iron.



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Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-saving Tools. Send for price List.
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Judges appointed by the officials at the World's Fair at Chicago have made awards to the Joseph Dixon Crucible Company, Jersey City, N. J., for superior products in graphite, lead pencils, plumbago, crucibles, black-lead stoppers and nozzles, dippers, bowls, foundry facings and lubricating graphite.

The Indiana Car and Foundry Company, Indianapolis, Ind., has about 140 men at work, largely on repair work. It is the intention of the company to be in the field for new work as well as paying a good deal of attention to general repair work. Indianapolis being so much of a railroad center as to throw a good deal of such work there.

S. Norris Craven, proprietor of the Howard Foundry and Machine Works, 17 South Eighteenth street, will remove about November 1, 1893, and will continue business at his new plant, 515 Mulberry street, Philadelphia, in the manufacture of elevators of all kinds, forming presses, plate presses, shearing and rolling machines, and general machine work, under the title of S. Norris Craven & Co., Limited.

A Wheeling, W. Va., dispatch says: The Belmont Nail Works, a part of the Wheeling Iron and Steel Company, started up, October 16, after an idleness of five months and a partial idleness of a year. This will give employment to over 500 men. The Bessemer furnace of the same concern will resume within a few weeks. It was closed last July, and since then has been practically rebuilt, and its capacity increased nearly one-half. The action of President Chambers of the Window Glass Trust, in resigning his position and withdrawing his factory from the compact, insures that the window glass factories in Bellaire will go to work within a few weeks, almost at the old rates and terms, a thing the union has been fighting for since last June. The pottery industry of Wheeling has 200 more men at work than last week, and many more will find employment this week.

The J. A. Fay & Egan Co., Cincinnati, O., write us to say that they have captured the "grand honors" at Chicago. A partial list of the machines being, by J. A Fay & Co. department, No. 4 eight-roll triple cylinder sandpapering machine; hollow chisel car mortising and boring machine; automatic double cutting-off saw machine (for car and bridge work); No. 6 fret scroll sawing machine; triple cylinder six-roll "lightning" flooring machine; large sill and timber dressing planer; automatic dovetailing machine (self-feeding), etc., etc., and by the Egan Company department, improved universal wood-worker; No. 10 double planer and smoother, with broken roll and chip breaker; No. 6 band re-saw (capacity 40,000 feet per day); car gaining and tenoning machine; automatic spoke lathe, record of 2,695 spokes per day; sandpapering machine with brush attachment; heavy timber planer with eight powerful feed rolls; reciprocating No. 3 scroll saw machine, etc., etc.

Machinists' Supplies and Iron.

New York, October 21, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.75 to $14.50 for No. 1 Foundry; $12.50 to $13.50 for No. 2, and $11.75 to $12.50 for Gray Forge.

Antimony—The market is dull at a decline. We quote L. X., 9¾c.; Cookson's, 10c. to 10½c.; Hallett's, 9.60c. to 9.65c., and U. S. French Star, 10c.

Lard Oil—Prime City is quoted at 75c. to 76c.

Copper—The market is dull and weak. Lake Copper is quoted at 9.65c. to 9.70c. Casting Copper is held at 9.15c. to 9.30c.

Lead—The market is inactive, 3.35c. to 3.40c. is asked for prompt delivery, although some business in futures has been done at the last named figure, buyers are inclined to limit their bids to 3.30c. to 3.35c.

Spelter—The market is dull; 3.60c. to 3.65c. is asked for New York delivery, but buyers are indifferent

Tin—The market is easy and steady at 20.85c. asked for spot, 20.85c. for October and November, and 21c. for December.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

First-class draftsman and M. E. wants position. Box 111, American Machinist.

Exp'd draftsman in all branches, eight yrs' exp.; highest refs. Box 99, American Machinist.

Tracer and detailer desires permanent position, 8 yrs' exp. Box 117, American Machinist.

Wanted—Position as machine shop foreman, engine work pref'd, refs. given. R. D., Am. Mach.

Mechanical draftsman, good designer, wants situation. Address Box 77, American Machinist.

Wanted—Position as foreman of machine shop, or to build machinery by contract. Address Box 118, American Machinist.

Wanted—Position as foreman or assist. foreman in mach. works; 21 yrs.' exp; age, 38; steam pumps preferred. Address R. K., Box 115, Am. Machinist.

A mechanical engineer and salesman with 15 years' practical exp. and first-class references is open to engagement as salesman or superintendent of machine works. Box 119, Am. Machinist.

Wanted—Thoroughly competent foreman for established job foundry who can invest $5,000 in the business; foundry equipped with all modern improvements. Address A. P. H., Am. Machinist.

A young man who has worked from apprentice to superintendent, with no influence except ability and attention to business, is thoroughly practical; expert on Corliss engines and heavy machinery, desires situation. Box 113, American Machinist.

European grad. eng. with 2 yrs'. exp. in navy yard and machine shop, 1½ yrs in a foundry as assist. supt., and 4 yrs. as draftsman on structural iron work and gen. mach'y, is open for engagement. O. S., American Machinist.

Draftsman and good vise hand has some experience in designing stationary and haulage engines; wishes position, or would like to take a small interest in a well-located small machine shop. Address W. A., American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Draftsmen's new comb. triangles, etc.; cir. free; small sample, 10c. D. J. Kelsey, New Haven, Conn.

Drawings made of jigs, fixtures, special tools and devices to work in best possible manner. Address Box 62, Providence, R I.

For sale one 2"x24' Jones & Lamson flat turret lathe, triple-geared head, new, will sell low. Address Box 116, American Machinist.

Wanted Machinist—Foundry doing good business in growing Iowa town offers exceptionally good inducements to practical machinist to start machine shop in connection. Box 120, Am. Mach.

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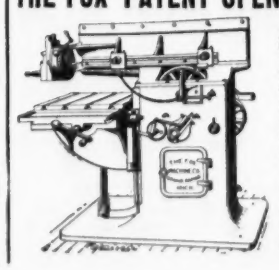

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8	1¾	1.10	17	5½	4.00
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1 Set to 2 in.		7.80	Full Set.		31 10

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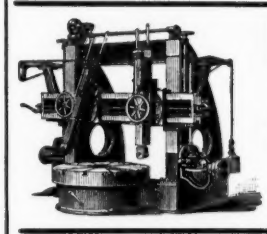

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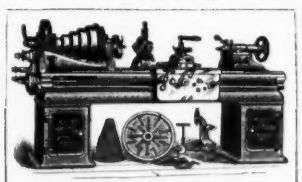

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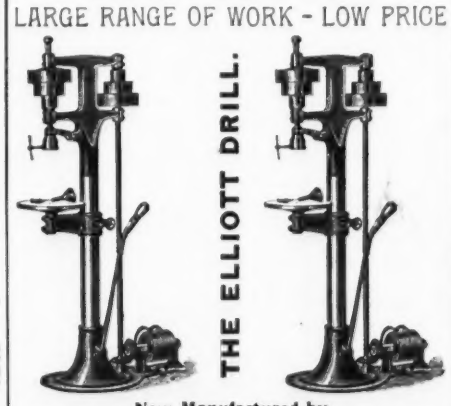

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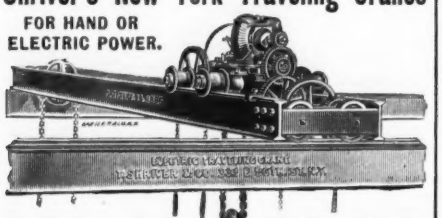

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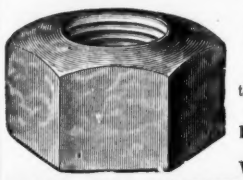

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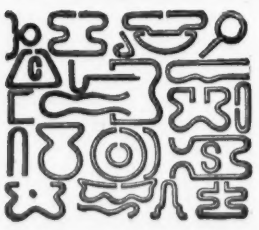

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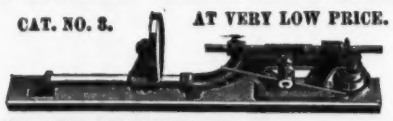

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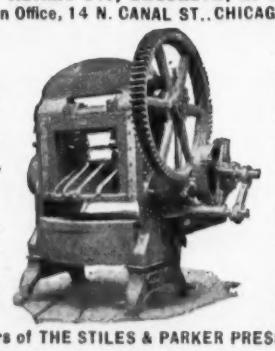

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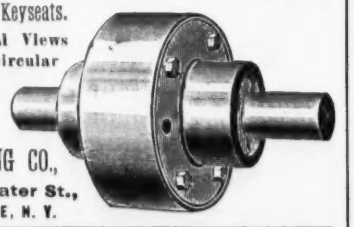

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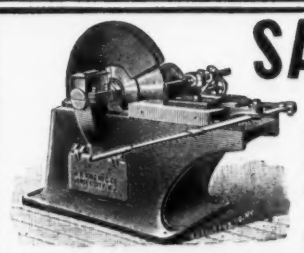

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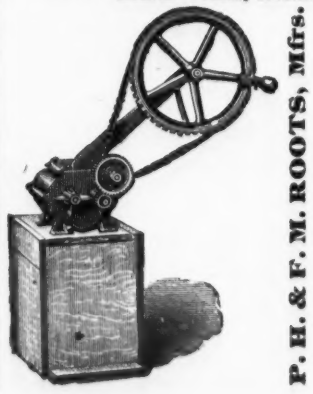

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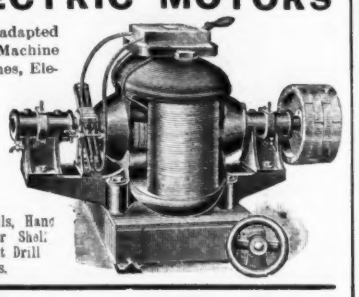

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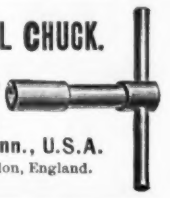

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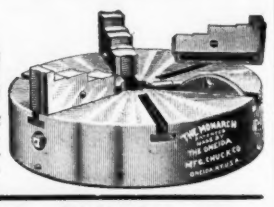

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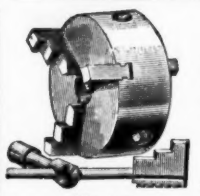

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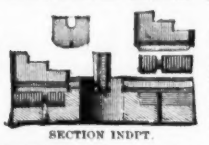

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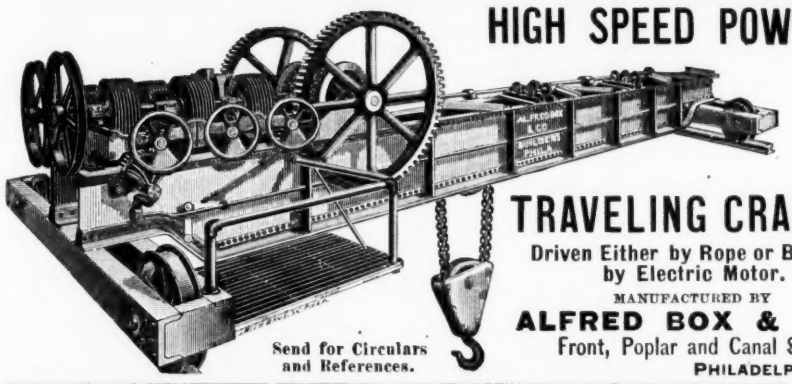

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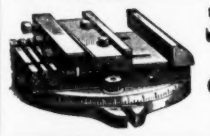

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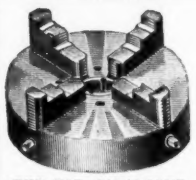

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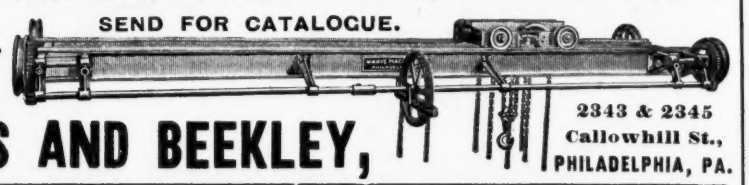

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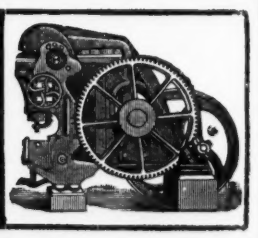

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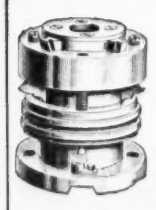

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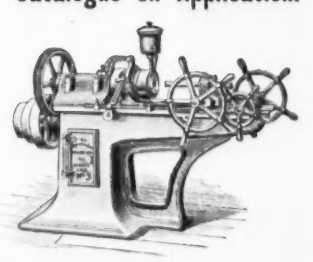

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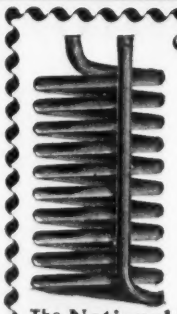

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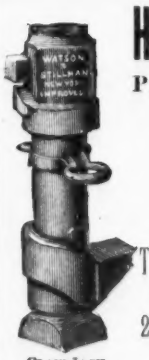

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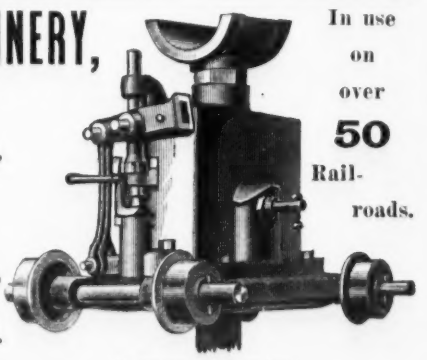

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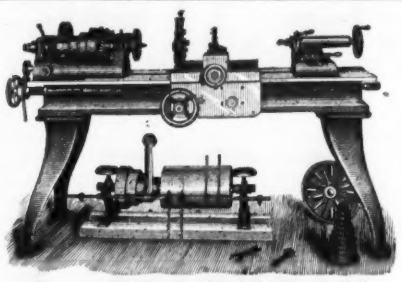

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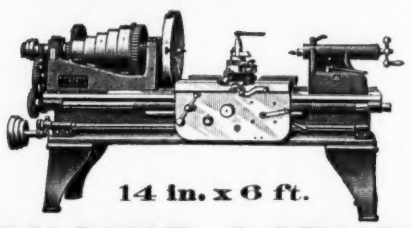

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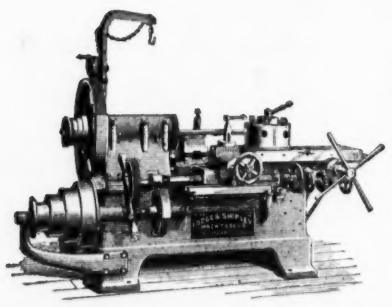

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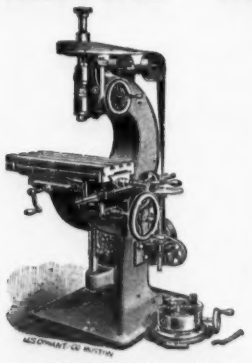

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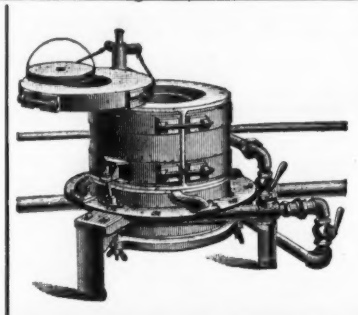

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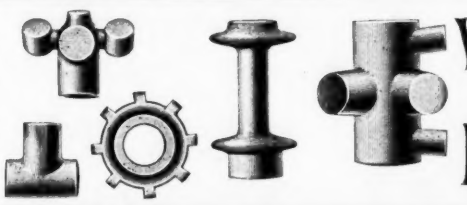

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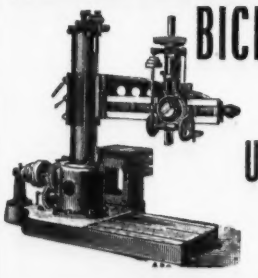

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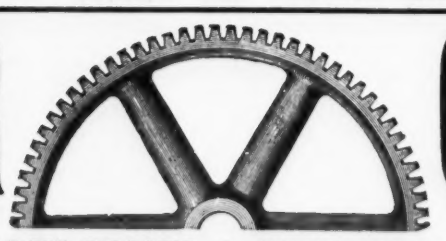
GEARING  **CUTTING**
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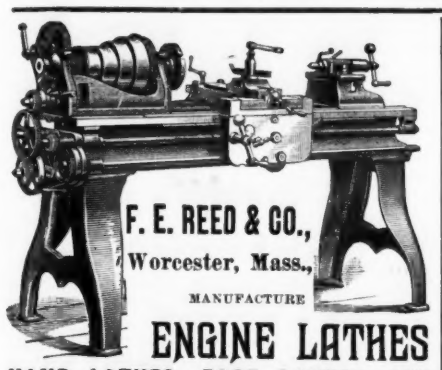

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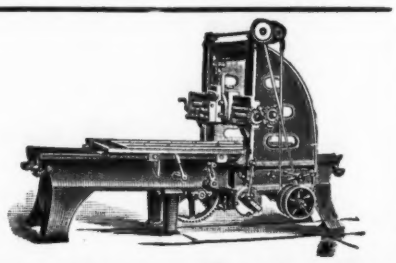

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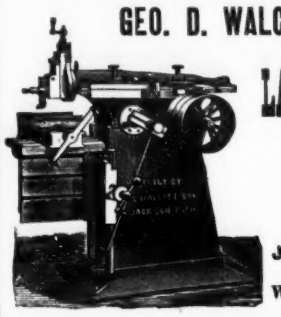

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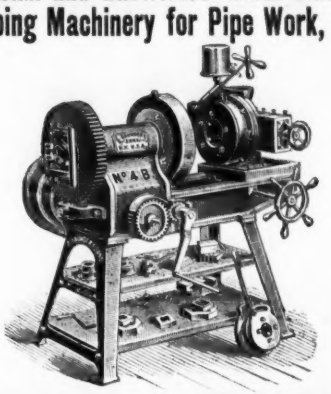

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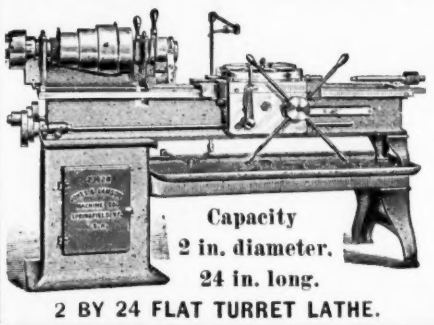

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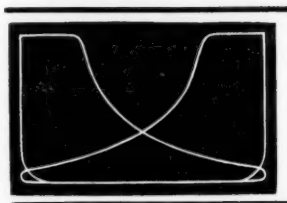

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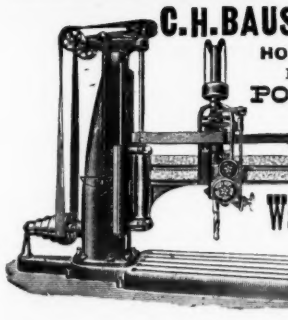

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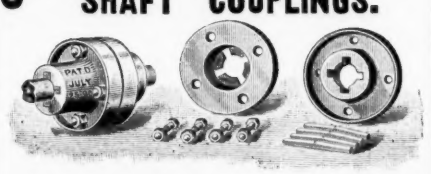

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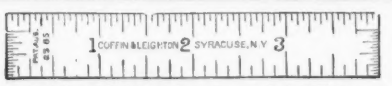

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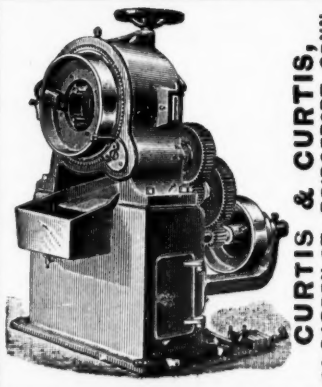

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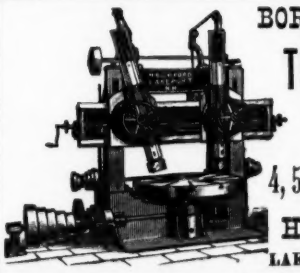

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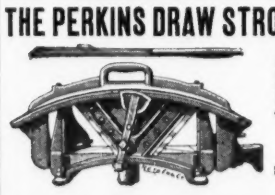

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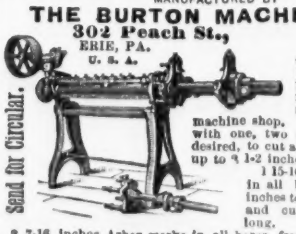

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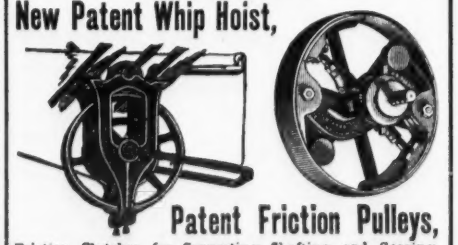

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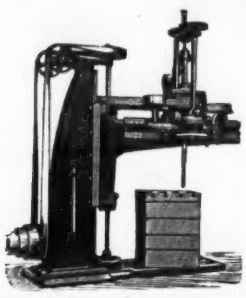

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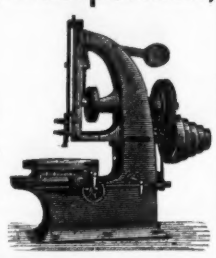

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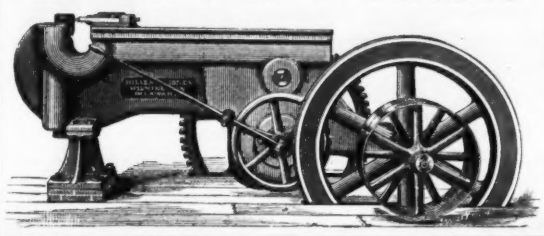

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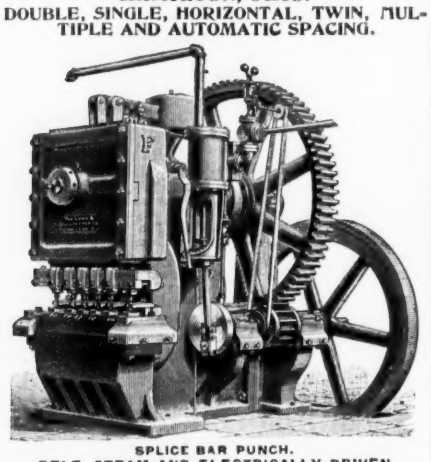

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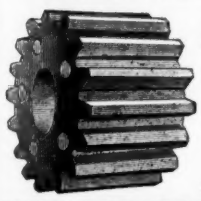

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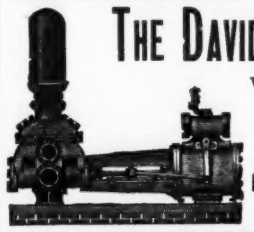

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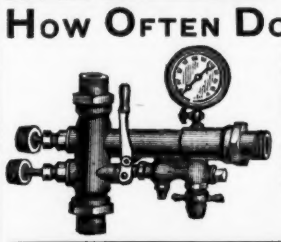

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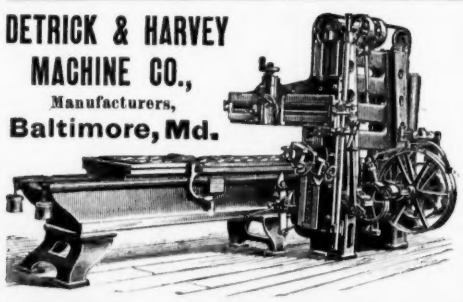

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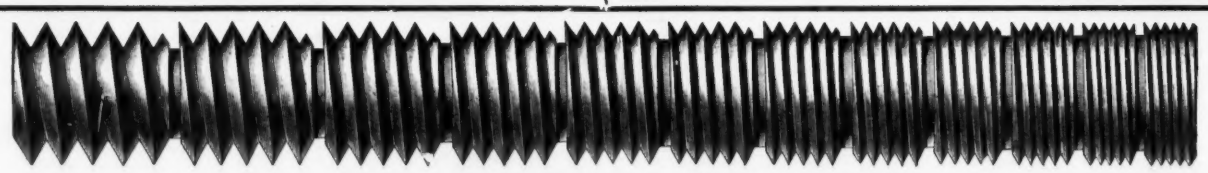

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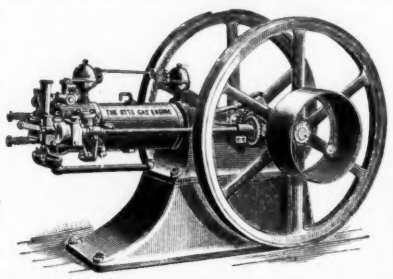

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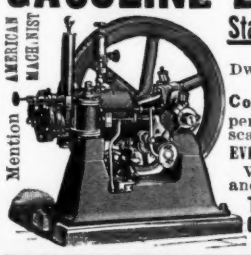

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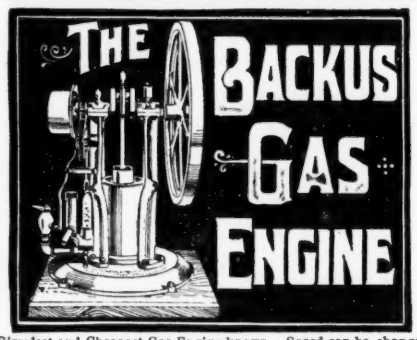

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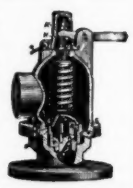

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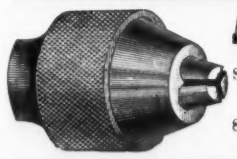

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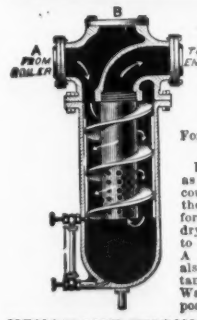

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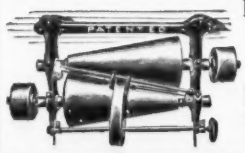

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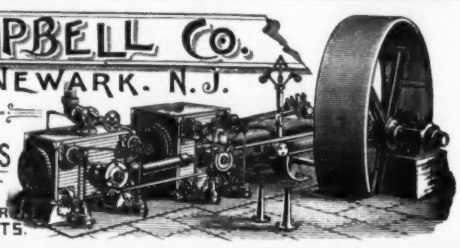

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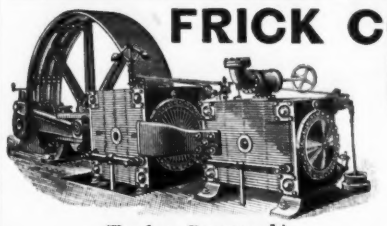

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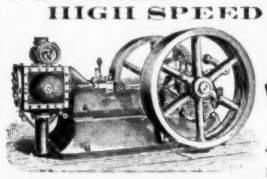

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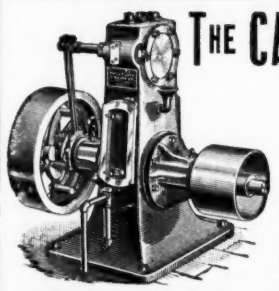

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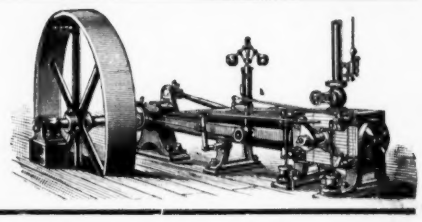

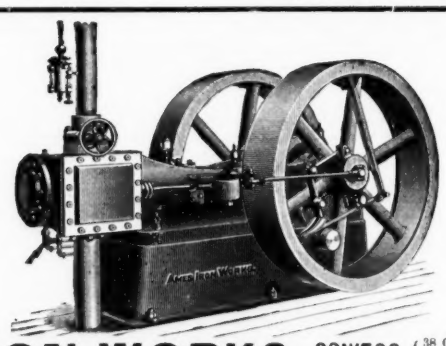

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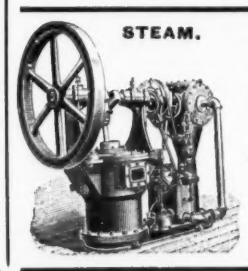

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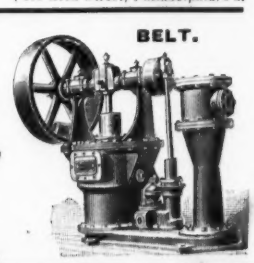

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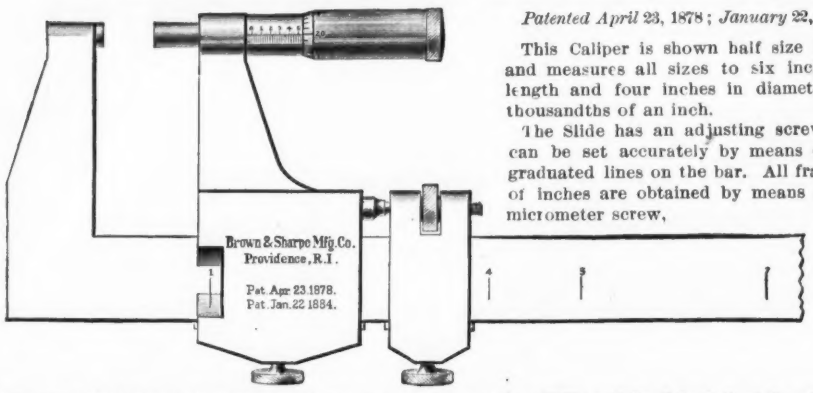

Patented April 23, 1878; *January* 22, 1884.

This Caliper is shown half size in cut and measures all sizes to six inches in length and four inches in diameter, by thousandths of an inch.

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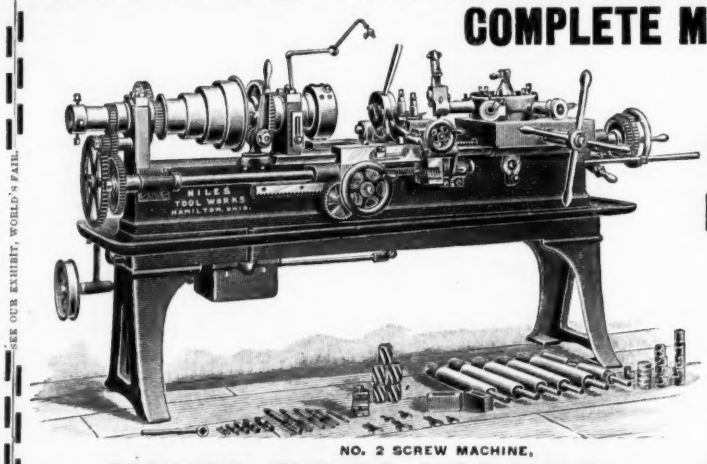

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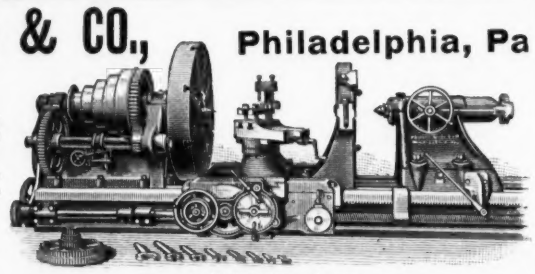

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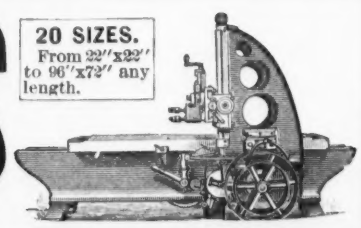

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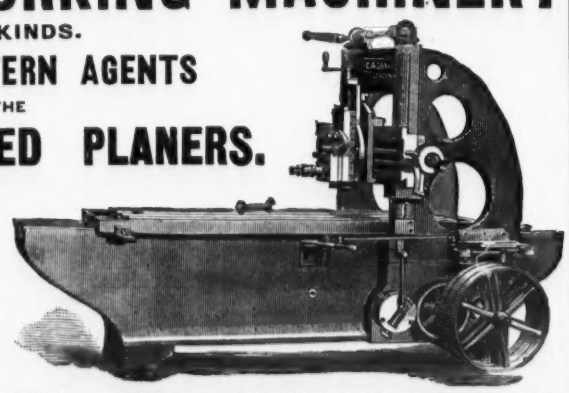

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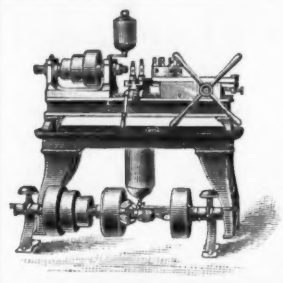

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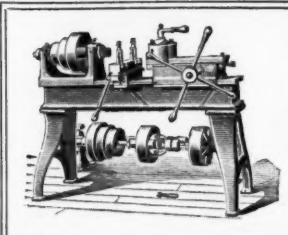

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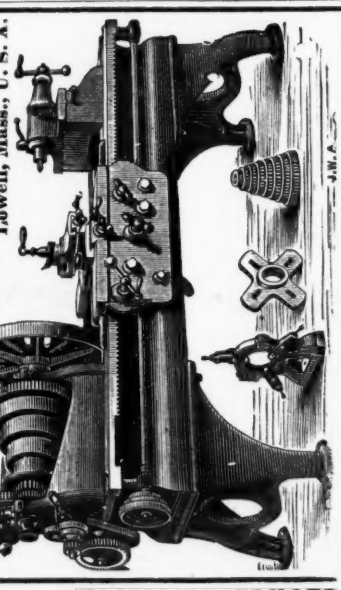

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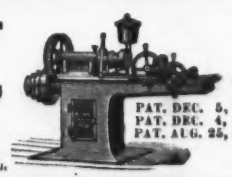

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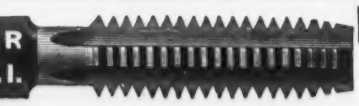

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